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PROTECTION AGAINST LIGHTNING.

A recent note read before the French Academy of Sciences gives some curious details with reference to lightning protection at high elevations. There are two little observatories on Mount Blanc. The earlier one founded by the late M. Janssen, stands on the perpetual snow of the mountain-top, and in arranging to protect it from the lightning storms, which are not infrequent there, it was necessary to make an earth connection by a cable 100 m in length. With the observatory thus insulated on snow except for this earth connection, protection against lightning has proved to be practically out of the question, and in spite of all the efforts made to install protective devices the observatory has been repeatedly struck and both instruments and observers have been injured. The other observatory stands on rock and the metal work practically surrounds it and is grounded on the rock. This structure has never been struck, at least in any way that has produced injury. The indications seem to be that the long earth connection is very unfavorable, possibly owing to its choking effect, perhaps also to the fact that it, with the building to which it is connected, affords the only easy path to ground over a considerable area, which would perhaps insure its getting struck more often than would naturally be expected. A discharge of the violence commonly found in lightning is very apt to do incidental mischief even when a fairly good path to earth is provided, and 100 m of cable is certainly not a good ground compared with the direct connection of what amounts to a metal cage to the rock on which it is founded.

It must not be supposed, however, that even a metallic cage offers complete protection against injury from lightning, as it is only a few years since a small party took refuge in a sheet-steel crib in Lake Michigan and was annihilated by a lightning stroke. The men were in a practically closed conducting shell grounded in a large lake, but nevertheless received a sufficient amount of the discharge to be fatal. The long and short of the matter is that with discharges of sufficient voltage to have a striking distance of half a mile or more, as frequently happens in case of lightning, all moderate insulation spaces and insulators are too trivial to insure relief from the violence of the discharge. Only very complete protection, and that under favorable circumstances, seems to be able to avert mischief. The most that can be said on the subject is that, on the whole, the better the ground the less likelihood of serious damage. Lightning protection for buildings or even for aerial lines is not yet exactly worked down to a science or even an art. The investigation of cases such as the one here considered is a thing very well worth while, since it at least gives a clew to some of the more conspicuous difficulties of the situation.

MOTOR GENERATORS, CONVERTERS AND RECTIFIERS.

One of the reports presented at the Turin International Electrotechnical Congress was by Prof. Silvanus P. Thompson, on "Motor Generators, Converters and Rectifiers," and was written in the lucid and forceful literary style that characterizes the books of this well-known writer. There is perhaps no subject in the field of electrotechnics which needs international standardization of nomenclature so much as the subject of Professor Thompson's paper. Thus, the machine which is called in our A. I. E. E. standardization rules a "motor converter" is called in the paper, and generally throughout Europe, a "cascade converter." On the other hand, what the paper calls "converters" we call "synchronous converters," although both the paper and our own rules recognize the unfortunate prevalent use of the term "rotary converter." It is to be hoped that before very long such unnecessary differences in names for one and the same type of machine may be eradicated by mutual international agreement.

The paper alludes to the long controversy waged between the advocates of motor generators and synchronous converters respectively, but sums up in favor of the converter. In this country the controversy was of short duration only, and the converter soon dominated the field, almost to the exclusion of its rival. In Europe, on the contrary, the motor generator has always been more popular, and even at the present time remains in extensive use. A description is given of a type of converter called the "revolving-field converter," which in this country has not come into use, and which is not very common in Europe. It consists of a dynamic inversion of the ordinary converter. That is, instead of having a stationary field-magnet system and commutator brushes, with a rotary armature, it has a stationary armature and a rotary magnet and brushes. The advantages claimed for this structure of converter are not specified in the paper, except that the rotor field-pole need not be wound, being magnetized by the stator winding.

Special attention is given in the paper to a recent type of converting machine not mentioned in our standardization rules, namely, the "auto-converter," also called the "split-pole converter." This machine employs two sets of separately excited poles in the field-magnet system. The two sets of poles co-operate side by side and behave as though each main pole were subdivided into two portions. Consequently, two north poles follow and alternate with two south poles, instead of the single north pole and the single south pole in the usual type of machine. By exciting the two sets of poles in different ways, a variety of different types of machine can be and already have been produced. Thus, the applications specified are for direct-current balancers, boosters and three-wire generators, variable-speed generators for train lighting, synchronous converters for supplying two different direct-current voltages, constant-current machines, step-down direct-current converters, voltage-regulating machines, converters from constant potential to constant current, etc. It is evident that this principle, which has also been employed in the United States for regulating the delivery voltage of converters, is a fecund one for many other purposes.

INDUCTION-MOTOR DESIGN CONSTANTS.

The squirrel-cage type of polyphase induction motor possesses input characteristics identical, except as to relative magnitude, with a stationary transformer of equivalent rating, and its output characteristics are even more nearly similar to those of a shunt-wound direct-current motor built for the same service. It is logical, therefore, for the designer to employ with this machine methods representing compromises between the corresponding methods used in designing transformers and direct-current motors. One feature never considered in direct-current motor design and often ignored in designing transformers, but of almost predominating importance in determining the proportions of induction motors, is the power factor, the value of which depends largely upon the depth of the air-gap and dimensions of the primary coils. Closely related to the power factor are the starting characteristics and the operating temperature. The former depends largely upon the mechanical arrangements of the primary coils and upon the variable losses, while the latter relates to the magnitude of the exciting current and the constant losses. The interrelations between the many variables connected with the performance of an induction motor are indicated in a clear manner in the simple circle diagram, which possesses sufficient accuracy for all commercial-design purposes. The use of the simple circle diagram in connection with simplified design constants is described in an article by Prof. A. Miller Gray in this issue. The constants given are based on standard induction motor designs, and for use with such machines should prove of much interest and value. However, as is true with all design constants, it would be unsafe to assume them to be applicable with a high degree of accuracy to machines departing widely in proportion from standard lines.

ELECTRICAL RESISTANCE OF SOLID-METAL SOLUTIONS.

It is now generally supposed that the essential difference between a substance in the solid, liquid and gaseous states is merely in regard to the freedom of motion of its molecules. In the gaseous state these are free to oscillate over a relatively long mean free path, whereas in the liquid, and particularly in the solid, state the range of free molecular movement is very much more restricted. In other respects there is reason for supposing that the behavior of the molecules of a substance in these three states is very much alike. The "gas constant" is found to be a characteristic constant of certain phenomena of the same substance in liquid states, and the "liquid constant" is likewise found to make its appearance in certain attributes of the solid state. Diffusion, or the property of unaided mutual interpenetration, is essentially and markedly a characteristic of gases. Two different gases brought into volume juxtaposition without disturbance are found speedily to diffuse into each other across the surface of original separation. The same property, although greatly reduced in intensity and rapidity, is manifested between a pair of different liquids placed in mutual contact. Ordinarily it is supposed that diffusion does not occur between solids, but the property is still possessed by solids, although to a relatively very feeble extent. The rapidity with which diffusion can occur be-

tween the molecules of solid bodies in contact depends on the nature of the substances, the pressure exerted across the area of intercontact and the temperature of the contact layers. In general, high pressures and temperatures favor the process.

An article printed on page 1605, based on the work of Messrs. Bruni and Meneghini, describes an interesting experiment tending to show that a compound wire of nickel and copper, the former forming the core and the latter the external coating, was converted into an alloy wire of "constantan" after about a week's exposure to a steadily maintained temperature of 1000 deg. C. In such a case the diffusion of the molecules of the two metals into each other would continue until there ceased to be any discontinuity of metallic quality at the original bounding surface of contact. In this case the electrical resistance of the heated wire enabled its average molecular state to be estimated as the experiment continued, since the resistivity of constantan alloy is much greater than that of either of its two constituent metals. But in the ordinary process of metallic diffusion at ordinary room temperatures the action is extremely slow and very much more difficult to detect.

THE SENSITIVENESS OF WIRELESS-TELEGRAPH CONTACT DETECTORS.

There are two kinds of contact detectors recognized in the art of wireless telegraphy; namely, loose-contact detectors and tight-contact detectors. This classification sounds very simple, and indeed applies wonderfully well; but the subject is much more complicated than the classification suggests, and its ultimate ramifications run into the yet unknown properties and laws of matter in various directions. The original coherer of Onesti, Branly and Popoff, as developed by Lodge, Marconi and others, was a loose-contact detector, in which the loose contact occurred between adjacent particles of the same substance, or at least between essentially similar adjacent particles. The loose contact had a very high normal initial resistance, until the impact of the received electromagnetic wave broke its resistance down. This typical and original form of coherer had to be agitated back to its initial non-conducting state, ready for the reception of the next impulse. Later varieties of loose-contact detectors developed special peculiarities, deviations from the original type. There were some, called anti-coherers, that had an initial and normal lower resistance, which became increased on the impact of the received wave. There were both coherers and anti-coherers which were automatically self-restoring, and which needed no jar or agitation after the reception of each signal. In nearly every case such detectors employed loose contacts between different materials, as, for instance, an oil-film contact between metal and mercury, or a contact between carbon and mercury. In every case the mechanical contact had to be loose and flimsy, so as to produce a poor electrical contact, with a relatively high resistance in the same, which contact resistance became modified suddenly by the impact of the received electric wave.

As practical signal-receiving instruments all of these loose-contact devices gave more or less trouble, owing to the inherent flimsiness and delicacy of their adjustment. Looking back upon their use, it is wonderful that they worked as well as they did. When they were "Hobson's choice," and no better devices were available, they had to be coaxed into operation by dint of patience and vituperation, a combination of rare efficacy in times of trouble. In the corresponding history of the development of the telephone there was first a time in which the only available transmitter was a receiving telephone used as a generator—a very imperfect makeshift. Then came the stage in which the carbon microphone imperfect-contact transmitter was discovered, and finally a stage in which, instead of there being no independent available transmitter, there was a superabundance of transmitters. A few iron nails thrown together haphazard or a hot wire fastened to a diaphragm would serve. It seemed hard to avoid producing a telephone transmitter. So there was a stage in the development of loose-contact wireless-telegraph receivers when it seemed hard to avoid producing receivers on assembling conductors in loose contact. A complete change came, however, in the history of detectors when the loose-contact devices were rejected in favor of constant-resistance, tight-contact, current-operated devices.

At first tight-contact devices were less sensitive than the coherers; but later they surpassed the best coherers in sensitiveness. One type of such device is the "crystal" receiver, which is a misleading term; for, although many crystalline substances enter as an element into this type, yet some amorphous substances enter also. The essential elements of this type are a lump of suitable substance, such as carborundum, and a tight contact, over a circumscribed area, between this and the active electrode. Just how this device acts is a debatable matter in detail, but it is clear that current passes through the contact more easily in one direction than in the other. Unquestionably heat is produced at the restricted contact area, and it is supposed that, under the influence of this heat, the crystalline, or quasi-crystalline, substance develops unilateral conductivity at the tight contact. The curious fact is that the effect is highly localized, because the blunt contact needle pressing on the crystal, and carried from point to point over the surface of the latter, encounters successively little areas of strong and weak action, although no difference in the surface quality of the crystal can be detected in any other manner. It became evident at a later stage in the development of the crystal receiver that the effect could be produced, at least to some extent, in a great variety of substances, and it began to rain crystal receivers. Thus, the old Hughes microphone, employing a steel needle resting delicately in contact with a carbon plate, and intended to operate as a loose contacter, was found capable of producing some effect as a tight-contact detector, although an effect very small by comparison with that of the best crystals. The article by Messrs. Harris and Hogan on page 1602 of this number gives experimental evidence of the essential difference between the action of loose-contact detectors, like that of the Hughes microphone, and current-operated, tight-contact crystalline detectors. With the former the sensitiveness is a maximum at very light pressure of contact and diminishes rapidly as pressure is applied. With the latter the conditions are reversed.

Overhead-Line Construction.

At the December meeting of the executive committee of the National Electric Light Association a resolution presented by the special committee to which was referred the report of the overhead-line construction committee was unanimously carried. The resolution adopted is as follows:

"*Resolved*, That the executive committee commend the able and exhaustive report of the committee on overhead-line construction submitted at the last convention of the association to the favorable consideration of member companies. It sets out with great clearness and particularity a high standard of practice, which, in the opinion of this committee, should be regarded as a standard toward which all companies should strive. Local conditions or special considerations may, however, in particular cases, make the adoption of the recommendations of the report in whole or in part impracticable or inadvisable, and non-compliance therewith in such cases would not necessarily be bad practice. Upon the whole, however, we consider the report as embodying the best standard of overhead-line construction which has been suggested, and indorse it with the qualifications hereinbefore set forth."

It will be recalled that at the time the report was presented at the convention in New York last May certain features of it were subjected to criticism. The American Electric Railway Engineering Association objected to the section on the joint use of poles without further conference, and certain Class A members found fault with the fourth section of the report, dealing with crossings, and also questioned the advisability of adopting the recommendations of the committee without giving minute consideration to the legal questions involved. After much discussion it was agreed to thrust the responsibility of final action on the executive committee, and a motion recommending to the executive committee the adoption of the report was carried. Subsequently the Pennsylvania Electric Association, at its convention in Exposition Park, Pa., in September, feeling that it would be unjust to commit the smaller electric-light companies to any standard which might jeopardize investments or rights, asked that its objections be given consideration in connection with the adoption of the national committee's report. Many Class A members in addition had their lawyers report on the legal status of the report in case of lawsuits involving questions of standard construction. It would appear from the wording of the resolution of the executive committee that the objections raised were not without weight.

Resuscitation from Electric Shock.

Through the co-operation of the National Electric Light Association, the American Medical Association and the American Institute of Electrical Engineers plans have been perfected for a thorough study of methods of resuscitation from electric shock and the preparation of a set of rules for the practical application of the best means for resuscitation, the rules to be issued by the National Electric Light Association.

The members of the committee to carry on the work were appointed by the American Medical Association at the request of the National Electric Light Association and represent these two bodies and the American Institute of Electrical Engineers. It is probable that the scope of the investigation will be made international in character by the appointment of an international commission to report on some important details or of an advisory committee consisting of foreign authorities on the subject of electric shock. Following is the membership of the general committee which will have direct charge of the work:

Nominated by the American Medical Association: Chairman, Dr. W. B. Cannon, professor of physiology, Harvard University; Dr. Yandell Henderson, professor of physiology, Yale University; Dr. S. J. Meltzer, Rockefeller Institute, New York; Dr. George W. Crile, professor of clinical surgery, Western Reserve University, Cleveland, a distinguished authority on heart action; Mr. W. D. Weaver, editor *Electrical World*, secretary. *Nominated by National Electric Light Association:* Dr. Edward A. Spitzka, professor of anatomy, Jefferson Medical College, Philadelphia, who has made a special study of electrical accidents; Mr. W. C. L. Eglin, past-president National Electric Light Association, Philadelphia Electric Company. *Nominated by American Institute of Electrical Engineers:* Prof. Elihu Thomson; Dr. A. E. Kennelly.

Service-Annuity System Presented to Employees of Commonwealth Edison Company at Christmas.

Dated Dec. 23, 1911, and sent out by Mr. Samuel Insull, the president, with the compliments of the season, the board of directors of the Commonwealth Edison Company of Chicago made an announcement of unusual interest. This announcement is to the effect that at a meeting held on Nov. 21 the board of directors of the company adopted a plan for the creation of a service-annuity system, with a view of making some provision for faithful employees who have completed a certain term of service. The plan contains the following provisions:

First—That any employee who shall have reached the age of fifty-five years and shall have been in the service of the company for thirty years or more next preceding his retirement shall, upon his request, if approved by the service-annuity committee, be retired from active service with a service annuity.

Second—That any employee who shall have reached the age of sixty years and shall have been in the service of the company for fifteen years or more next preceding his retirement shall, upon his request and at the discretion of the service-annuity committee, be retired from active service with a service annuity.

Third—That any employee who shall have reached the age of sixty-five years and who shall have been in the service of the company for fifteen years or more next preceding the date upon which he shall have reached the above age shall be retired from active service with a service annuity unless the board of directors shall, for special reason, continue any such employee in active service without a service annuity.

Subject to the provisions of the plan, the amount of the service annuity to be paid each year to an employee retired under the system shall, in general, be as follows:

Two per cent of the average annual pay of such employee during the particular consecutive five years of service when his average pay was the highest, multiplied by the number of years of his service, provided that in no case shall the service annuity paid to any employee in any year be less than $240. Service in the company, as defined in the plan, includes service in the Commonwealth Edison Company and in any company which has been wholly merged into or acquired by the Commonwealth Edison Company or any of its predecessor companies prior to June 1, 1910.

The system is to be administered by a committee of five, of which the president of the company is ex officio a member and the chairman and the secretary of the company (Mr. W. A. Fox) is ex officio a member and the secretary. The other three members of the committee for the first year have been appointed by the board and are Messrs. Louis A. Ferguson, W. L. Abbott and J. H. Goehst. The system will become effective on Jan. 1, 1912.

The service-annuity system of the Commonwealth Edison

Company is based to a large extent on the report of the public policy committee of the National Electric Light Association, and it is one of the most important results of the very important work in this direction which that committee has carried out, along with other aspects of welfare work. One significant feature of the new service-annuity system of the Commonwealth Edison Company is that the company bears all the expense. No deductions whatever are made from the salaries or wages of employees in order to create a fund to defray, or partially defray, the annuities. The company has at the present time about 3200 employees.

Program of Byllesby Convention.

The third annual convention of H. M. Byllesby & Company and affiliated companies will be held in the Congress Hotel, Chicago, on Jan. 2, 3, 4 and 5. Mr. T. K. Jackson, of Mobile, is chairman of the convention, and the executive committee consists of Messrs. H. M. Byllesby, A. S. Huey, O. E. Osthoff, J. S. Cummins, J. J. O'Brien and R. J. Graf. There will be addresses by Mr. Byllesby, Mr. Jackson, Mr. George B. Caldwell, Mr. J. R. McKee, Gen. George H. Harries, Mr. Osthoff, Mr. B. E. Sunny, Mr. T. C. Martin and others. Technical and commercial papers on the program are as follows: *Steam Heating*, Mr. A. E. Stevens; *High-Pressure Gas*, Mr. H. H. Jones; *Profitable Business in Small Towns*, Mr. H. E. Morton; *Contact with the Public*, Mr. W. H. Hodge; *Accounting*, Mr. B. W. Lynch; *Staff Co-operation*, Mr. W. R. Molinard; *Jurisdiction of State and Municipal Bodies*, Mr. Isaac Milkewitch; *Appraisal Work*, Mr. Harold Almert; *New-Business Methods*, Mr. E. L. Callahan; *The Manager and the New-Business Department*, Mr. A. F. Douglass; *Byllesby Investment Club*, Mr. R. J. Graf. There will be a reception at the home of Mr. Byllesby on the evening of Jan. 3 and a banquet at the hotel, with prominent men as speakers, on the evening of Jan. 5. Mr. F. H. Tidnam is chairman of the committee on arrangements, Mr. R. M. Jennings of the reception committee, and Mr. Lincoln Beerbower of the entertainment committee.

Proposed General Traction Consolidation in Chicago.

Negotiations having for their purpose the ultimate general consolidation of the elevated and surface railway companies in Chicago are proceeding slowly. A valuation commission is at work to determine the valuation of the properties of the elevated-railway companies, the valuation of the surface-railway companies having been determined in the traction settlement ordinances of 1907. The present commission consists of Mr. John Ericson, city engineer; Messrs. E. C. Shankland and J. J. Reynolds, members of the Subway Commission of the city of Chicago; Mr. George Weston, the city representative on the Board of Supervising Engineers, Chicago Traction, and Prof. George F. Swain, of Harvard University, who represents the companies. Professor Swain is the engineer of the Massachusetts Board of Railway Commissioners and is also a member of the Boston Transit Commission. It is interesting to note that the valuation commission is instructed to consider the following elements of cost:

(1) The cost of reproducing the tangible physical property new at the present time.

(2) The present depreciated value of the tangible physical property.

(3) The value of the franchises, leases, contracts, etc.

(4) The loss of interest in the past below what would be a fair return on the capital invested.

(5) The treatment of obsolete or abandoned property.

The suggestion that the commission report on all these elements of cost came from the companies, and the city agreed to make these valuations, without, however, binding itself to take into consideration any other items than the actual physical value of the present tangible physical property. In a communication dated Dec. 18 the representatives of the companies made it clear that on their part this stipulation was understood and agreed to—that is, that the report of the valuation commission, while going into all the details mentioned, was not to be considered binding either on the city or the companies. This communication was signed by Mr. Henry A. Blair, representing the Chicago Railways Company; Mr. Ira M. Cobe, representing the Chicago City, Southern Street and Calumet & South Chicago Railway companies, and Mr. Samuel Insull, representing the Chicago Elevated Railways.

The project of combining all the elevated and surface railways of Chicago is intimately connected with the building of the proposed subway. Very likely the subway will be built by the city and leased to the companies for operation, but no conclusion has been reached on the subject. While the negotiations are proceeding so far in an amicable spirit, the interests involved are very large and important, and it will be some time before a plan of settlement can be worked out in all its details.

Chicago Investigation of Smoke Abatement and Electrification of Railway Terminals.

At the "municipal dinner" given by the Chicago Association of Commerce on the evening of Nov. 28 the first official progress report of the Chicago Association of Commerce committee of investigation on smoke abatement and electrification of railway terminals was made public. This report, prepared under the supervision of the chief engineer for the committee, took the form of a sketch of the origin and progress of the investigation of the subjects mentioned in the long title of the committee.

By way of introduction to the report a brief history of smoke abatement in Chicago was given, leading up to the statement that in the report of the smoke inspector of Chicago for 1910 it was declared frankly that there was necessity of a radical change in existing conditions of smoke abatement, so far as the railways are concerned; in fact, the electrification of railway terminals within the city was recommended in explicit form.

FORMATION OF THE COMMITTEE.

The recent history of the agitation for railway-terminal electrification in Chicago is recounted, both as taken up by the city authorities and by the Chicago Association of Commerce. In October, 1909, a committee of experts appointed by the latter reported favorably on electrification as a mechanical problem, but was less confident as to the financial feasibility of the proposal. About that time co-operation between the city administration and the Association of Commerce was suggested, with the formation of a joint committee of investigation. It was understood that the railways would provide the funds for the promotion of the investigation.

At a meeting of the association held in September, 1910, the leading representatives of a dozen different railways declared that the electrification of the railway terminals in Chicago would involve an enormous expense which would have to be borne by the commerce of the city and that immediate electrification was premature. Smoke abatement, it was added, need not depend wholly upon electrification. At a meeting of the Chicago Association of Commerce held on March 18, 1911, a general committee of eighteen was appointed to investigate the whole subject. This committee consisted of representatives of the city, steam-railway executives and other citizens. Its personnel has been

given in this journal, but it may be repeated that Mr. Jesse Holdom is chairman and Mr. Frederick H. Rawson secretary. It is this committee under whose auspices the present elaborate investigation is being conducted.

ENGINEERING STAFF AND SCOPE OF INVESTIGATION.

The engineering staff organized to do the work of this committee is as follows: Chief engineer, Mr. Horace G. Burt; electrical engineer, Mr. Hugh Pattison; terminal engineer, Mr. Louis H. Evans; mechanical engineer, Mr. Theodore H. Curtis; consulting electrical engineers, Messrs. Gibbs & Hill, of New York; consulting mechanical engineer, Mr. George R. Henderson, of Philadelphia; assistant engineer, Mr. James Walker; editor for the engineers' staff, Mr. Benjamin C. Burt. Headquarters are maintained in the People's Gas Building, Chicago.

The scope of the investigation includes: (1) A determination as to the necessity of changing the motive power of steam railways to electric or other power; (2) the mechanical or technical feasibility of such a change; (3) the financial practicability of such a change. In the scope of the investigation as to the necessity of changing the motive power of steam roads to electric or other power are embraced the following heads: (1) Safety, (2) health, (3) comfort and convenience, (4) questions of loss and damage. Under each of these heads are included the subdivisions "passengers," "employees" and "the public." Each of these subdivisions is in turn subdivided.

WHAT HAS BEEN DONE.

One feature of the investigation is the obtaining of information on yard locomotives, freight trains, freight transfer trains, passenger transfer trains and passenger trains operating within the city and in and out of the city. Much of the attention of the engineering staff so far has been devoted to the smoke-abatement portion of the problem. A great deal of information has been collected on the subject. A definite conclusion has been reached in relation to the use of coke as locomotive fuel, and it has been decided to eliminate coke entirely from further consideration.

Such subjects as brick arches and stack blowers in locomotives, as well as down-draft furnaces, steam jets and under-feed stokers, have received much attention. Various printed documents have been issued by the committee and a memorandum of maps has been prepared for the study of the territory or territories covered by the investigation. Various advisory committees to the general committee have been formed.

GENERAL STATEMENT.

In concluding its progress report the Chicago Association of Commerce committee of investigation on smoke abatement and electrification of railway terminals says that the investigation so far (the report is dated Nov. 24, 1911) has been chiefly occupied with the subject of locomotive-smoke abatement. It is expected that in the course of the next few months tangible developments will appear in the handling of the matter of electrification. The concluding sentences of the report are as follows:

"In proportion as it has progressed the problems presenting themselves for solution have rather increased than diminished in number, and it is sufficiently clear, even at the present stage, that for the accomplishment of definite and valuable results much labor and considerable time will be required. The task imposed upon the committee proves to be one that is rather special, even unique, in scope and character, and while much may be learned from what has already been accomplished in various lines, yet much will have to be done *de novo* or for the first time. It is confidently hoped, and even believed, that if that which has to be done is well done the results will be of interest and value not only for the present time and place, but for other times and places as well."

Increased New York City Street Lighting.

Work is nearing completion on the installation by the Department of Water Supply, Gas and Electricity of New York City of new and additional street lamps in extensive districts, which has been made possible by the saving early this year of $70,000 by Commissioner Henry S. Thompson in obtaining from the New York Edison Company a reduction in the price per kilowatt-hour for electric lighting in public buildings. When the work is all completed the principal sections to be lighted by means of this saving will have their illumination doubled, and on some avenues the mantle type of gas lamps will be replaced by electric lamps. A great many additional arc lamps are also being installed throughout the city, which are being paid for by money that has also been saved by the department, this time through the reduction in the price to the city of arc lamps which went into effect in the latter part of the first year of Commissioner Thompson's administration. An arrangement was obtained by which when a certain number of arc lamps were installed the price should be reduced from the old figure of $100 to $95. This gave a saving which, when the work is completed, will enable the installation of 550 new arc lamps. This arrangement is so drawn that this proportionate reduction will continue year by year, the next reduction being from $95 to $90 per lamp, and will enable the installation of many more arc lamps.

Illuminating Engineers Undertake a Civic Service in Chicago.

At a joint meeting of the Chicago Section of the Illuminating Engineering Society and the Car Lighting Club of Chicago held on Dec. 20 the subject of the hanging of the powerful 10-amp flaming-arc lamps for street lighting now on test in the Loop district of Chicago was brought up. It was held that the lamps as temporarily installed (many on elevated-railway structures) are too low, not only dazzling the eyes of the people on the streets, but not attaining their maximum efficiency as light-giving sources. It was thought that the men who have made a technical study of illumination might do a practical service to their fellow citizens by giving their advice on this subject to the city authorities. Two committees were appointed to make an investigation of the subject jointly and to report their conclusions to their respective organizations. These committees are: For the Chicago Section of the Illuminating Engineering Society, Messrs. James R. Cravath, T. H. Aldrich and Prof. William E. Barrows; for the Car Lighting Club, Messrs. C. R. Gilman, Edward Wray and George W. Cravens. Mr. Cravath is chairman of the joint committee. The joint committee was also requested to confer with the officers of the elevated-railway companies of Chicago to see if measures cannot be taken to improve the lighting of the cars on the elevated-railway lines.

Present Status of the Patent Monopoly.

In a recently issued circular George H. Benjamin, Esq., of New York City, discusses the bearing of recent court decisions on the scope of the patent monopoly. The general impression, he says, seems to prevail that the terms of the Sherman act and the construction of such act by the Supreme Court in the Standard Oil and tobacco cases are directly opposed to the terms of such sections of the United States statutes as grant protection to inventors for their inventions for a specific term, and he pronounces this impression to be incorrect. In no one of the petitions filed by the Attorney General is there, he says, any allegation that

the exercise of a monopoly specified in a patent or patents is in violation of the terms of the Sherman act, and the only attempts on the part of the government to restrict the right of inventors are as follows:

First—In the consent decree entered into in the case of the electric lamp trust. In this case the government contended that after a manufacturer working under a patent had sold the article manufactured his right to exercise any further control over it (either as regards its use or price for which it might be sold) ceased, and the General Electric Company accepted this contention notwithstanding the fact that the United States circuit courts had held to the contrary.

Second—In the language used in the showing, preliminary to indictment, in the case of the United States versus Sidney W. Winslow and others (so-called shoe-machinery trust). In this case the government takes the position that consolidation of patents all relating to a single industry is unlawful where such consolidation acts to produce a restraint which would not be possible were such patents in the hands of individual owners—the statement of the government being that by reason of the consolidation of shoe-machinery patents the monopolies and rights created under such patents are extended and expanded unreasonably at the expense of shoe manufacturers, and that the combination is used oppressively as a means of building up monopolies over and above the power and control warranted and permitted by the letters patent, and to use the power and control when so built up for grasping and drawing to the combination the rights which might have been carried on by others for controlling and enhancing the prices of such shoe machinery and discouraging and preventing others from inventing or manufacturing other devices and machines for doing the work done by the machines, etc.

From the above, Mr. Benjamin says, it will be seen that the attack by the government is not against monopolies created by patents, but against agreements, combinations and the like based upon the patents and intended to exercise a control in an industry beyond that conveyed by the patent grants. In short, the government takes the position that an inventor may exercise an absolute monopoly in the thing covered by his patent grant, but that neither he nor any combination of individuals or interests may use such patent grant as a basis for exercising a monopoly or control in an industry which is beyond and external to the monopoly of the patent grant. To keep within the Sherman law, therefore, manufacturers should, Mr. Benjamin states, remember: (1) That they can make no agreement with purchasers, agents or distributors by reason of which the use of the re-selling price of the articles is fixed and determined; (2) that no agreement may be made between individual owners of separate patents, or business conducted by the single owner (be it individual or corporation) of a group of patents in an industry, where the purpose of the agreement or the nature of carrying on of the business is such as to obtain an extension of the monopoly created by the patents, or, in other words, effect a control or partial control of an industry and thus unreasonably restrain and hamper the trade of others.

Mr. Benjamin also calls the attention of manufacturers to the fact that, as it is evident that it is the intention of the government to cut off all exterior aids to business in the form of agreements, such protection as may be had through the means of patents and trade-marks should not be neglected. The principal manufacturing companies of the country have, he says, recognized this fact and are now applying for patents, not only for the articles manufactured by them, but for the processes and the machinery employed in producing the articles.

The circular also discusses the present Patent Office status. It is stated that inventors have much to complain of in the condition of affairs in the Patent Office and the general tendency of the United States courts as regards patents. "In the last *Official Gazette*, published Oct. 24, 1911, it is authoritatively stated that there are some 20,403 applications awaiting action; that is, applications which have not even been considered by the Patent Office. This number does not really represent all the applications pending in the Patent Office, as a large number of applications are involved in interferences or in other proceedings by reason of which their consideration is delayed. It is probably within the facts to state that fully 35,000 applications are awaiting action. This condition of affairs is certainly outrageous, as the American inventor pays the entire cost of operation of the Patent Office and yearly turns a surplus into the Treasury. The reasons for the delays are (1) an inadequate, underpaid force, and (2) the indisposition of the present officials of the Patent Office to exercise that liberality in the treatment of inventors which is recognized both in the constitutional provision and in subsequent statute laws relating to patents as warranted and proper.

"The trouble in the courts seems to be largely due, as recently stated by an eminent judge, to the fact that the judges are called upon to decide questions about which they have no technical information and their unwillingness to accept the statements of petty and prejudiced so-called experts. The judges naturally desire to understand an invention or a question of infringement before rendering a decision, and they very frequently find it quite impossible to do so. As a result, the decisions depend largely upon the personal prejudices of the judge before whom the case is tried. If he is favorable to patents, he will sustain a patent or find an infringement; if, on the contrary, he is opposed to patents, he will not sustain the patent, will find no invention and in very many cases no infringement.

"There can be no doubt that before long the situation in the Patent Office and the courts must be radically changed. The proceedings in the Patent Office should be very materially simplified, and the judges who hear patent cases should be given the advantage of technical counsel to be selected by themselves upon whose advice they can rely."

The statement as to the present condition of business in the Patent Office is at variance with a statement on the same subject by the Commissioner of Patents in his annual report, recently issued under date of Oct. 20, from which the following extract is made:

"The work of this bureau is at present in a very satisfactory condition and practically up to date in all its branches. Of course the work naturally falls into arrears during the period of the year from July 1 to Oct. 1, which is the time when the force is taking its annual leaves of absence; but it is always brought up to date by Dec. 31 each year, and continues so until the next vacation period comes around.

"Congress has been fairly liberal in its appropriations for the Patent Office by increasing its force and salaries and providing new positions, and I have thus been able to bring about, during my incumbency of the office of commissioner, many needed reforms. I think I may safely say that the bureau is in better condition than ever before as regards the transaction of business and the salaries paid employees."

The report refers to the accumulation of applications as follows, in connection with a recommendation of legislation to require that an application for a patent shall be prosecuted within six months after any action by the Patent Office:

"The present period within which the applicant is allowed to amend is one year, and under the existing practice there have been many instances of cases being amended just within the one-year limit, in order to keep them alive, they thus serving as dragnets in many cases to catch inventions along similar lines which may be subsequently applied for, thereby involving inventors in expensive interference proceedings. It has been the effort of the office

to get the old cases out of the office whenever possible consistently with good work. The office has been severely criticised recently, especially in the last year or two, for allowing applications, particularly those owned by corporations, to rest in the office for such long periods as really to have the effect of extending the patent period in case such applications are later passed to issue. Instructions have been repeatedly given to the examining corps to get rid, as far as possible, of all such cases as are delayed apparently by the applicant or his attorney. Had this bill passed it would have almost entirely overcome that criticism."

Extension of an English Patent.

By an English Legal Contributor.

The American inventor who has obtained protection in England must needs take care that his monopoly does not expire before he has time to reap the fruits of it. No doubt an additional stimulus to manufacture in Great Britain was given by the "compulsory working" act which was passed a few years ago; but, nevertheless, for some inventions the period of fourteen years is sometimes too brief.

A thousand causes may operate to prevent a patentee bringing his wares to market at once. It may be an invention which involves the construction of a large machine which will only be used in one or two cities in a state. Again he may be hampered by the laws of his own or of foreign governments.

For instance, suppose a patent facilitated the use of the telegraph. Such a patent could not be worked in England at all unless the Postmaster-General—who has a monopoly in telegraphic matters—could be persuaded to take it on and he would be able to ask his own price. The same now applies to telephones in England, because the Postmaster-General is about to acquire the entire business of the National Telephone Company.

In these circumstances it is of interest to inquire when, if ever, and in what circumstances, an English patentee can obtain a prolongation of his patent beyond fourteen years. The material section of the relevant English statute provides that a patentee may, after advertising in manner provided by rules of the Supreme Court his intention to do so, present a petition to the court praying that his patent be extended for a further term, but such petition must be presented at least six months before the expiration of the patent. Any person may give notice to the court of objection to the extension.

On the hearing of any petition under this section, the patentee and any person who has given such notice of objection shall be made parties to the proceeding, and the comptroller shall be entitled to appear and be heard, and shall appear if so directed by the court. The court, in considering its decision, shall have regard to the nature and merits of the invention in relation to the public, to the profits made by the patentee as such, and to all the circumstances of the case.

If it appears to the court that the patentee has been inadequately remunerated by his patent, the court may, by order, extend the term of the patent for a further term not exceeding seven, or in exceptional cases fourteen, years, or may order the grant of a new patent for such terms as may be specified in the order and containing any restriction, conditions, and provisions the court may think fit to impose.

This provision partly re-enacts an older law and partly introduces new matter. The principles on which the court will act have been summarized by Mr. Roberts in his work on English patents as follows:

1. The nature and merits of the invention in relation to the public must be of an exceptional nature. "Merit" does not refer to the moral claim of the inventor to be rewarded for personal trouble, but to the value of the invention he has given to the public. This must be much more than what is required to support the validity of a patent. But the conduct and position of the inventor or applicant is also a matter for consideration. For instance, extension was refused where the British patent was held merely to protect the market and the patented articles were made and imported from abroad. In another case where the patentee had kept secret the exact proportions necessary for carrying out his invention, and as the Privy Council were of opinion that these were the essence of the invention, they refused a prolongation on these grounds.

2. In order to ascertain the profits made by the patentee as such, proper accounts must be kept. They must be so kept and exhibited to the court that it may be apparent what profit, if any, has been made from the patent as distinguished from mere profits of manufacture. Where profits of manufacture are attributable to the existence of the patent they must be disclosed and will be considered.

3. Where the applicant for an extension is an assignee of the original inventor he must show that he has done something to merit the grant, as, for instance, by incurring large expenditure in bringing the invention into public notice, or otherwise assisting the inventor. He must also show that the inventor has been adequately remunerated, and will derive further remuneration by the proposed extension.

4. In considering the question of remuneration of the patentee, the profits arising from foreign patents or from articles made for sale abroad will be included. The books must be kept and accounts exhibited so as to include them.

5. The utmost good faith must be shown, and the history of the patent fully disclosed. Delays in working must be explained. The existence of licenses, the facts connected with the formation of companies when applicants, the value of their shares as shown by dealings in them and like matters should be fully stated.

6. The validity of the patent is not considered, although the question of novelty may be gone into in order to determine the merit of the invention.

A comparatively recent case in the English courts has drawn from the judge who generally tries this class of case a further expression of opinion. He said: (a) The court must consider the nature and importance of the disclosure made in the specification to the public, and for that purpose questions of novelty and subject matter are material; and it is the duty of the petitioner for an extension of term to bring to the notice of the court all that may in any way affect the judgment of the court in those matters. But if after hearing the evidence of the petitioner's witnesses, there is in the opinion of the court a *prima facie* case for upholding the validity of the patent in respect of novelty and subject matter, the court need not, as a general rule, investigate the matter further, it being always open to an objector to challenge the validity of the patent in proceedings more appropriate for that purpose.

(b) For the purpose of considering whether a patentee has been adequately remunerated, profits on his corresponding foreign patents as well as on his English patents must be taken into account, and some allowance ought also to be made for profits which will in all probability be received in respect of both before their expiration.

(c) It is incumbent on a patentee who petitions for an extension of his patent to prove that he has done all that a patentee could do to launch his invention on the British market. He ought also to state all facts which are within his knowledge and which it is obviously material that the court should know.

(d) When the comptroller of the Patent Office opposes the extension of a patent on the ground that the traders of this country will, if the patent is prolonged, be put at a disadvantage compared with the traders of some other

country, proper statistics or other information ought to be supplied to the court as to the nature and extent of the competition which is feared.

It will be seen from this that to obtain an extension, an American patentee must be prepared to show that he has taken active steps in England to do what he can to further his invention.

In conclusion, it may be said that an extension is a privilege not easily obtained or lightly granted by the court. All the circumstances of the case have to be considered; and the fact that the patentee has already made a large profit out of the invention in the States would militate against his chances.

The Drawn-Wire Tungsten Lamp.

A joint meeting of the Chicago Section of the Illuminating Engineering Society and of the Car Lighting Club of the same city was held on the evening of Dec. 20. Mr. C. W. Bender, commercial engineer of the National Electric Lamp Association, addressed the meeting on "The Drawn-Wire Mazda Lamp." The discussion, however, which was of a rather desultory character, took a wider range than the title of the address would indicate.

Mr. Bender described the process of drawing tungsten wire from ingots through diamond dies. Drawn-wire tungsten filaments have been found to be stronger at the end of the life of the lamp than pressed filaments of the same metal after a few hours' burning. The drawn-wire filament may be used in any position in which carbon or tantalum lamps are used, and is well adapted for lighting street cars. A recent test in street-car operation showed an average life of a large number of 40-watt drawn-wire lamps of 1452 hours. The drawn-wire lamps are almost exclusively used now in all of the new installations for automobile and car lighting. The filaments are mounted on a central spider in much the same manner as the tantalum filament is mounted. As the result of a number of tests it seems to be established that with energy at 10 cents a kw-hour the best consumption of the drawn-wire lamp varies from 1.03 watts to 1.22 watts per candle.

One objection to the drawn-wire lamp is its comparatively early blacking compared with the pressed-filament lamp, but even with this drawback the lamp still exhibits a life of 1000 or more hours up to 80 per cent of the initial mean horizontal candle-power. Further, as this blacking effect increases the tip lighting by some reflection from the inside of the blackened zone, the figure for 1000 hours' burning is 85 per cent for mean spherical candle-power. It might be well, said Mr. Bender, if the lamp were rated in mean spherical candle-power.

In discussion Mr. T. H. Aldrich asked why in American drawn-wire lamps the filaments are not put near the central support, as in foreign lamps. Mr. Bender answered that all lamp design is a compromise. If a spider of smaller diameter is used there is a greater opportunity for the filaments to short-circuit. Furthermore, this contracted spider results in greater heating of the central glass stem and so causes blacking from that source. In answer to other questions Mr. Bender said that he believed 220-volt drawn-wire lamps are entirely satisfactory. He added that one of the advantages of the drawn-wire lamp over the pressed-filament lamp is its greater uniformity, which makes both for better efficiency and better candle-power maintenance. Another interesting statement made by the speaker of the evening was that the lamp manufacturers are now able to offer 15-watt drawn-wire tungsten lamps for 110-volt circuits.

In relation to car lighting Mr. C. R. Gilman asked about the relative advantages of 30-volt and 60-volt drawn-wire lamps. Mr. Bender answered that as far as the lamps were concerned there was little to choose between them, but probably for head-end train-lighting systems the 60-volt layout is more practical. Either one, however, is to be preferred to the 110-volt system for train lighting. A number of the railroad men present complained of the theft of lamps from cars. One advantage of a 60-volt or 30-volt lamp is that it cannot be used on the ordinary 110-volt circuits, and so the car-lamp thief is not apt to repeat his larcenous enterprise a second time. Mr. Gilman favors the 60-volt system for head-end lighting, but said that the 30-volt car-lighting system is probably the best where axle lighting is employed. Later on Mr. A. J. Farrelly, who presided at the meeting, made the interesting announcement that the Harriman lines, the Chicago & Northwestern and the Northern Pacific railroads are all going to adopt the 60-volt train-lighting system as standard.

One gentleman asked Mr. Bender what advantages, if any, were possessed by the drawn-wire lamp over the modern types of pressed-filament tungsten lamps in installations where there is no vibration, as in residence lighting. Mr. Bender said that in this case the newer type of lamp possesses hardly any advantages over the more familiar pressed-filament tungsten lamp, provided the pressed filament is properly mounted.

There was some discussion on the advantages of lock sockets to prevent the theft of lamps, but several of the gentlemen present seemed to think that the cost of the sockets would be greater than the loss of the lamps. Mr. J. R. Cravath asked when illuminating engineers and users of lamps might expect the distance between the center of the drawn-wire filament and the base of the lamp would be standardized for the various sizes. Mr. Bender contended that this standardization had been reached already by the lamp manufacturers, but Mr. Cravath remarked that while the drawings of the lamps showed standard dimensions in this respect, the lamps themselves did not.

Electric Propulsion of Ships.

At a joint meeting of the Boston Society of Civil Engineers and the Boston sections of the American Institute of Electrical Engineers and the American Society of Mechanical Engineers held on Dec. 20 Mr. W. L. R. Emmet, of the General Electric Company, Schenectady, N. Y., delivered an illustrated lecture upon the electric propulsion of ships. The speaker reiterated his well-known views upon the subject and emphasized the importance of securing trial installations in large ships, which offer the most attractive savings under operation by electric motors. The general advantages of the motor drive for high-powered propellers were reviewed, including a substantial reduction in the strains upon shafts, certainty of decreased fuel consumption through increase in prime-mover efficiency, extension of cruising radius and diminution in the weight of boilers, machinery and fuel to be carried.

Mr. Emmet contended that the engineering problem of ship propulsion by electric motors supplied with energy from turbo-generators is beset by no serious difficulties. The conservatism of large ship-builders and governmental officers appears to be the chief obstacle to the early application of a representative electrical installation on the large scale necessary for a striking demonstration of economy. It appears certain that when such an installation is made it will be done at a great decrease in initial cost as well as accompanied by radical reductions in operating expense. After several years of sustained effort permission has been secured from the United States government to equip the 20,000-ton collier *Jupiter* with electrical propulsion machinery, and, although delays are being experienced on account of the scarcity of suitable labor, the construction of the ship is now under way at the Mare Island Navy Yard. The

Jupiter will be equipped with 7000 hp in induction-motor propeller drives, the speed of the vessel being 14 knots. The equipment will weigh only 145 tons and will be located practically on the ship's bottom. It is expected that power will be delivered at the shaft with a steam consumption of 12 lb. per hp-hour. It will be impossible for the turbo-generator to deliver much more current upon short-circuit than the full-load current of the propeller motors. The apparatus is simple in the extreme. The turbine speed will be about 2000 r.p.m., which is high enough to enable the full economy of the turbine to be realized.

Taking up the problem of direct propeller driving of turbines, Mr. Emmet said that this involves speeds below the most efficient range of the prime movers, resulting in a great increase in size and cost, as well as a larger fuel consumption. The mechanical difficulties of driving propellers of large ships through gearing are very serious. In very small vessels gear drives may be reasonably successful, but in meeting the power demands of battleships and transatlantic liners the gearing problem is one of almost insuperable difficulty. High turbine speed is the secret of economical operation, and this can only be positively secured under present conditions by the electric motor drive. The weight of the 6800-hp triple-expansion engines of the similar collier *Cyclops* is 335 tons, or more than twice the weight of the propulsive equipment of the *Jupiter*, and the steam consumption of the former is probably about 14½ lb. per shaft hp-hour, or nearly 21 per cent more than is expected in the case of the electrically driven ship. For the same power the *Jupiter* turbine will weigh but one-tenth that of the direct-connected propeller turbines used on the *Lusitania*. The latter deliver 30,000 hp and are obliged to run at the low speed of 180 r.p.m., which prohibits securing the legitimate economy of this type of prime mover.

The speaker showed that the electrical equipment of a 17,000-hp liner built to run at 17.5 knots would save the owner $20,000 a year in fuel alone, without allowing for any reduction in boiler weight. In the transatlantic service this would enable the vessel to carry 900 tons additional cargo. The estimated steam consumptions were 14½ lb. with quadruple-expansion engines and 11 lb. with the turbo-electric drive. The cost of installing the latter would be at least $50,000 less than the bare expense of the engines. The labor cost of operating large marine engines is also far greater than the expense of handling the turbo-electric equipment. So great is the fuel saving possible with the electric drive that it is estimated that the battleship *Wyoming*, if electrically propelled, could travel at cruising speed two-thirds of the distance around the world with a single coaling. The details of auxiliary apparatus in connection with electric propulsion are being carefully developed, special attention having been given to the successful production of a form of salt-water-cooled resistance capable of absorbing large amounts of energy in connection with the reversal of the driving machinery. Over 350 kw have been absorbed by such an apparatus incased in a cylinder about 12 in. high and 6 in. in diameter. The speaker stated that as soon as the electrical equipment is completed at the factory it will be subjected to economy tests in which the conditions of propeller service will be to a large extent duplicated. Preliminary engineering analyses and many former turbine tests indicate that a great field for electrical service is close at hand.

Work of the Illuminating Engineering Society in London.

At a meeting of the Illuminating Engineering Society in London on Nov. 17, which opened a new year of work, Mr. Leon Gaster, honorary secretary, presented a summary of the progress made during the vacation. A feature of the work of the society from its commencement in 1909 has been its co-operation with other bodies. The secretary mentioned that during the vacation the society had been represented at quite a number of different congresses. For example, one of its members, Mr. J. Darch, read a paper on hospital lighting at the annual congress of the Royal Sanitary Institute in Belfast. During this gathering another paper on school lighting, by Mr. W. H. Webb, made special reference to the discussions of the Illuminating Engineering Society on this subject during the previous year and recommended the conclusions then arrived at to the attention of school inspectors. The society also encouraged the sending of exhibits on illumination to the International Hygienic Congress at Dresden.

The most important work carried out, however, was at the International Electrical Congress in Turin and at the meeting of the International Electrotechnical Commission in the same city. Secretary Gaster was present at these meetings, as were also Dr. A. E. Kennelly and Dr. C. H. Sharp, of the Illuminating Engineering Society in the United States.

At the meeting of the International Electrotechnical Commission the following resolution was passed unanimously: "Resolved, That the national committees should co-operate with the illuminating engineering societies in their respective countries in studying the questions of symbols, nomenclature and other matters relating to illumination."

At the congress in Turin Mr. Gaster read a paper entitled "The International Outlook in Scientific Illumination," in which he pointed to the vast field for concerted international action in illuminating engineering. He suggested that not only the more or less scientific matters connected with symbols, units, etc. (important as they are), but also many matters of industrial consequence, such as the hygienic aspects of lighting, the illumination required for different classes of work, etc., should be studied. He also drew attention to the variety of committees and institutions in different countries concerned with illumination and working on separate lines. This suggested the desirability of forming one central international commission which could deal with illumination in a thoroughly impartial and international manner. On such a commission the various committees interested should be represented.

This suggestion was subsequently embodied in a resolution which received unanimous support and was as follows: "Resolved, That this congress deems it desirable that an international commission should be appointed in order to study all systems of lighting and technical problems in connection therewith; and, having been informed that the Illuminating Engineering Society of London has the intention of forming such a commission and of putting itself in touch with the other existing national and international committees, approves their taking the initiative in this respect."

This, of course, is a most important recognition of the importance of the illuminating engineering movement, and it is also a remarkable precedent for an electrical congress to have considered it desirable for a commission to be appointed dealing with all illuminants.

Another matter of international interest which was mentioned in this report was the formation of a government committee on the hygienic aspects of lighting in France. On this committee prominent oculists, physiologists, engineers and factory inspectors are represented. It is intended to deal with the framing of standards of illumination for industrial purposes, the study of the nature and causes of defects in vision and their relation to lighting conditions, the measurement of illumination, etc. It is hoped that other countries will follow the example set by France. The Home Office in Great Britain has recently been paying special attention to this matter and has arranged for systematic tests of the illumination in factories.

Among other matters mentioned in the summary of progress was the work of the committee on the standard specifications for street lighting, which is still meeting in London and on which representatives of the (British) Illuminating Engineering Society, the institutions of gas and electrical engineers and the Association of Municipal and County Engineers are taking part. The (British) Illuminating Engineering Society has also nominated permanent committees to deal with school and library lighting. On these committees a number of members of the (British) Illuminating Engineering Society will act, and delegates from the Library Association, the Association of Technical Institutions, the Association of Teachers in Technical Institutions and the London Teachers' Association will also co-operate.

One other matter mentioned was the courses of lectures on illuminating engineering which have been arranged, under the direction of the London County Council, at three of the technical institutions in different parts of London. These lectures will deal with all illuminants, illumination and the eye, the measurement of light and illumination, practical lighting problems, etc., and will be delivered by experts in their respective departments. Two of these courses have already commenced (at the Battersea and Regent Street Polytechnics), and it is hoped that in the future lectures on these lines will become an integral part of the courses at many colleges and institutions, and that more advanced courses will ultimately be arranged.

The society has therefore been very active during the vacation, and an interesting series of papers has been arranged for the next session. The first of these, by Dr. H. R. B. Hickman, dealt mainly with different types of head-lamps, lens and mirror combinations, etc., an attempt being made to define the "glare" from these lamps and to discuss how far it can be avoided. Representatives of firms interested in the manufacture of automobile head-lamps and of the Royal Automobile Club were also present and joined in the discussion. Letters were read from the police authorities who had been interrogated regarding the effect of glare on traffic, and extracts on the regulations on this point, which demanded absence of glare and adequate lighting in general terms, were also read in the course of the discussion. The opinion was expressed that more precise definitions and tests were desirable.

Other points discussed were connected with the desirable width and spreading effect of beams of light, their effect on fog, the value of swiveling lamps in turning corners, etc.

In concluding the discussion the chairman, Mr. F. W. Goodenough, alluded to the program of papers to be read during the coming session, which included railway lighting, color discrimination by artificial light, and the lighting of shops and printing offices, respectively.

De Romas and the Lightning Kite.

BY BROTHER POTAMIAN.

The inhabitants of Nérac, a town 75 miles south of Bordeaux, showed their appreciation of an electrical pioneer of undoubted merit by erecting a statue in honor of their townsman, de Romas. The statue was dedicated quite recently with appropriate ceremonies and addresses in the presence of M. Armand Gauthier and M. d'Arsonval, both members of the Académie des Sciences.

In the middle of the eighteenth century the subject of atmospheric electricity attracted widespread attention. Franklin in America, d'Alibard and de Romas in France, Divisch in Bohemia, Toaldo in Italy and Richmann in Russia believed in the efficiency of pointed conductors for the purpose of exploration and protection; yet, in spite of the results which they obtained and the explanations which they gave, it was a long time before leaders and people took kindly to the "Franklinian" rod.

Franklin, be it said, was derided by the sapient Fellows of the Royal Society for his views on the nature of lightning, and the points of the royal conductors were covered with knobs by order of George III; but when truth prevailed over prejudice and personal hostility the knobs were removed, the points exposed to the clear view of heaven, and the American philosopher was ultimately honored by the Royal Society.

In the heart of Bohemia popular opposition ran high and strong against the new device to protect life and property against the bolts of heaven. The pastor of Prenditz, Divisch by name, was an expert electrician, considering his time. After experimenting privately in Prenditz and publicly in Vienna on the discharging power of points, he erected his "meteorological machine," as he called it, in an open space in the middle of the parish on June 15, 1754. It bristled with points, 323 in all, for this Bohemian wizard was convinced that fifty points would be more efficacious than five in discharging an ugly-looking cloud.

The day of trial finally came to the good parish priest of Prenditz, and from members of the flock for whose protection the "machine" had been erected. Unlike their electrical pastor, they distrusted the weird-looking mast with its multiple points and chains for ground connections. The conspiracy grew apace, and a day was fixed by the malcontents for the destruction of the evil-boding machine. In came a body of farmers from the surrounding district, who were led to attribute the failure of their crops to the influence of the evil-looking mast. There was mischief in their eye and grim determination in their Bohemian visages. At a sign from the leading demagogue they attacked the lightning conductor and wrecked it completely.

As a consequence of this act of vandalism Divisch, heeding the advice of his Premonstratensian Superiors, withdrew from the unscientific and unfriendly villagers of Prenditz and left them to the spiritual ministrations of another who probably would not seek to protect them against the destructive effects of lightning by any kind of a "meteorological machine" or "Franklinian" rod.

De Romas was more fortunate in his experience, for the people of Nérac and the country folk for miles around flocked to his experimental station to see the vivid flashes and hear the noisy discharges which he got from his tall, insulated rod.

But when he flew his electrical kite his troubles began. He was careful, as a man of science mindful of his reputation should be, to send detailed accounts of his achievements to the Académie of Bordeaux for insertion in its *Actes*, or transactions. Franklin was at the time rapidly ascending the meridian of fame; just a year before this he had, with the assistance of his son, raised his spiked kite in one of the fields of Philadelphia and definitely proved, by unassailable experiments made in that field and under the canopy of heaven, his contention that the electricity of the atmosphere was identical in kind with that of the frictional machine of his laboratory. This was in the month of June, 1752.

From the *Actes* of the Bordeaux academy we learn that de Romas raised his first electrical kite in May, 1753, but with no result, although rain fell and wet the hempen cord. Attributing the failure to want of conductivity, de Romas, like a good electrician, wrapped a fine copper wire round the entire length of the cord before he again went afield to test the electrical gradient of the atmosphere. This was on June 7, 1753. The day was stormy, threatening clouds came and went, and at the same time the lower end of the wire-wound cord gave out torrents of vicious sparks, to the delight of the magistrate-physicist.

De Romas repeated his dangerous experiment from time to time, not only to supply the *Actes* with new data and thereby enhance his reputation for all time, but also for

the instruction and entertainment of an ever-growing class of spectators. It is said that he used kites 7½ ft. long and 3 ft. wide; and, reeling out some 400 ft. or 500 ft. of wire-wrapped cord, obtained pistol-shot flashes reported to be 9 ft. long and 3 ft. thick—truly spectacular. Professor Richmann, of St. Petersburg, lost his life for much less. Franklin was fortunate, though imprudent, in taking sparks from his key-like prime conductor; but de Romas must have had a charmed life when drawing electrical energy at such a forbidding rate from passing clouds.

His disappointment remains to be told. He thought that the honor of using a kite to explore the electrical conditions of the atmosphere belonged to him and his country; he could not admit the possibility of a colonial one-time journeyman printer anticipating a magistrate of Nérac and electrical expert in such an important matter. He put forward his claims for priority and urged them with pertinacity; but the savants in Paris, the dispensers of fame, did not altogether share his opinion. Perhaps they were dazed with the extraordinary results on insulated rods obtained by d'Alibard, de Lor and de Buffon. He appealed to the academies of Bordeaux and Paris for recognition of the originality of his experiments, but in vain; and so the declining years of the life of this pioneer in lightning work were surrounded with sadness and the thickening gloom of bitter disappointment.

Doubtless this disappointment was deepened from the day when the countrymen of de Romas, gathered in solemn academical conclave in Paris, rose to their feet as Franklin crossed the threshold of the assembly room of the Académie des Sciences and the president greeted the American Prometheus with the first half of Turgot's hexameter *"Eripuit coelo fulmen."*

The facts of the case are that Benjamin Franklin flew his lightning kite in a field outside the city of Philadelphia in June, 1752, while de Romas raised his kite for the first time to the sky in May, 1753, without result, his initial success being obtained in the following month of June, 1753.

Turin International Electrical Congress.

Electrochemistry, Rates and Legislation.

In Section VII of the Turin International Electrical Congress papers on electrochemistry, electrometallurgy and storage batteries were presented, and in Section VIII papers on rates, taxation and legislation. Abstracts of these papers follow.

ELECTRICAL PHENOMENA IN THE INDUCTION FURNACE.

Treating the induction furnace as a special transformer, Dr. Sigm. Guggenheim develops a vector diagram of the emfs and currents, and discusses the effects of various design and operative factors upon the performance of this type of furnace. The earliest type of induction furnace, namely, the Kjellin type, is studied first. This type has a serious disadvantage in its extremely low power-factor, which decreases rapidly as the amount of the charge which forms the secondary circuit increases. For instance, a 1.5-ton furnace working at 25 cycles has a power-factor of 0.75 at 900-kg charge, which drops to 0.48 at 1800-kg charge. In order to keep the power-factor as high as practicable it is necessary to resort to very low frequencies. In large furnaces it would be necessary to go as low as 5 cycles per second in order to obtain a favorable power-factor. In this respect the Roechling-Rodenhauser furnace is a great improvement over the Kjellin furnaces. It has, in addition to the molten metal, a closed secondary circuit of relatively great resistance, which consists of a secondary winding leading to two large cast-iron pole pieces located at opposite sides of the hearth. These pole pieces are protected by a fire-resisting mass that is a very poor conductor at ordinary temperatures, but becomes a fairly good conductor at higher temperatures. This auxiliary secondary circuit serves several useful purposes; it increases the power-factor; it equalizes the heating, and it performs from 20 to 30 per cent of the total work. With the Roechling-Rodenhauser furnace frequencies as high as 50 cycles are used and the working power-factor is about 0.80.

The author next takes up the magnetic forces acting in the molten iron of both the Kjellin and the Roechling-Rodenhauser furnaces. The latter furnace under certain conditions is troubled with disturbances due to pinch effect. However, this has been overcome recently by an extremely ingenious expedient. The walls of that portion of the furnace where the molten metal is torn asunder by the electromagnetic force are made of a slightly conductive substance, and when the cross-section of the iron circuit becomes reduced more and more current is carried by the walls, and thus the rupture is avoided. This type of structure is also advantageous in starting, since it forms a closed circuit of high resistance and will carry the starting current until sufficient iron to form a closed circuit has been melted. Formerly it was necessary to start such furnaces with molten iron.

THE IRON-NICKEL BATTERY.

In reviewing the present status of the alkaline battery Mr. J. A. Montpellier gave Mr. M. Darrieus, a sea captain, credit for having first called attention to the principle of operation of the iron-nickel alkaline battery in 1893. In 1901 Jungner and Edison took out patents on this type of cell, and Edison placed his battery on the market. After this Edison continued his studies and introduced several important improvements at this time. Mr. Paul Gouin also worked on this type of battery, and to-day the Edison and Gouin cells are the ony alkali cells made on a commercial scale.

The author follows the historical introduction with a technical description of the Edison and Gouin cells, and then the two are compared. The Gouin cell has a slightly greater capacity per unit weight and also experiences no trouble from the precipitation of the active material from the positive plate, and the resistance changes very little after the battery has been in service.

Comparing the alkaline cell with the lead cell, the former has many points of superiority. It will stand more abuse than the lead battery without suffering any serious damage. For instance, with an alkali battery the rate can be carried to 20 watts or 25 watts per kilogram, while in lead batteries it should not exceed 7 watts or 8 watts. Alkali batteries for traction may be charged in two or three hours and stationary batteries in from three to five hours, while lead batteries require from three to five hours for vehicle work and from eight to ten hours in stationary work.

The total useful capacity per kilogram of the Gouin cell is from 20 to 25 per cent greater than the best lead cell, and on the volume basis the lead batteries for traction have a useful capacity of only 48 or 50 watt-hours per cu. dm, and those for stationary work have a capacity of from 12 to 15 watt-hours per cu. dm. On the other hand, the alkali cell for traction has a total capacity of from 55 to 60 watt-hours per cu. dm, and the stationary alkali battery has a total capacity of from 30 to 40 watt-hours per cu. dm.

On the score of efficiency it is said that the alkali battery compares very favorably with a lead battery, especially when the latter is old. Referring to the Gouin battery, the author states that its efficiency will remain constant ten times as long as the efficiency of a lead battery, the period being measured in terms of the number of discharges. As an example of efficiency it is stated that a stationary Gouin battery having a weight ratio of 18 or 20 watt-hours per kilogram will give an efficiency of from 60 to 62 per cent, while a lead battery under the same con-

ditions and when new will not show an efficiency greater than 65 per cent and its weight ratio will be only 5 or 6 watt-hours per kilogram.

Another point is the scrap value of the plates. The nickel plates are very valuable, while the lead plates have practically no value when exhausted.

STATIONARY AND PORTABLE BATTERY PRACTICE.

The present state of the art of storage-battery engineering was the subject of a report by Dr. H. Beckmann. He distinguishes two types of battery design, according to whether the battery is stationary or portable. In the stationary class the design has become fairly well standardized and perfected, and to-day this type of battery is regarded as one of the most reliable of all electrical appliances. Many companies guarantee the care for the upkeep of the battery for a given amount per year. This practice places the cost of maintenance at a low and definitely fixed value, and has done much to establish confidence in storage-battery installations.

The largest and most important use of storage batteries is in connection with continuous-current distribution plants to care for the peak loads and to assure continuity of service. In Germany there has grown up a practice among large central-station customers of installing storage-battery plants, which are charged during off-peak hours at a very low cost. In Berlin there are fifty such batteries, having an aggregate capacity of 13,000 kw-hours at the three-hour rate.

An interesting application of a storage battery is afforded by a spinning mill in Italy, which is operated by electricity from a water-power. The mill had been running twenty-four hours a day when a law was passed forbidding the employment of women on night shifts, and therefore the plant had to be doubled, and by installing a storage battery to be charged during the night the same power plant was able to operate under the new régime. This battery has been in continuous service for about six years.

Installations which have as a prime object the maintenance of continuity of service rather than economy are more popular in the United States than those installed to improve economy of operation. The forty-four batteries of the New York Edison Company, with a total capacity of 32,000 kw-hours, are cited as exemplifying this practice.

Passing to the buffer batteries used in connection with boosters to maintain good regulation, the author briefly mentions various systems used in the operation of direct-current and alternating-current systems. Examples of the use of batteries on single-phase railway lines are cited, and the opinion is offered that the single-phase railway must give way to the high-tension, direct-current railway operated in conjunction with storage batteries, because of the technical as well as the economical superiority of the latter.

Portable storage-battery practice is more diverse, there being several distinct types, some of which, like the Edison, are adapted exclusively for this kind of service. In Europe the storage-battery locomotive has made great strides. The Prussian railroads have been using it since 1896, and they now have 140 such machines in actual service.

The electric vehicle is having its greatest development in the United States. In Cleveland alone there are almost twice as many electric vehicles as in the whole of Germany. This enormous development in the use of storage-battery motor cars is credited to the concerted efforts of the makers and the central station, and special credit is given to the publicity campaign of the *Electrical World*.

In conclusion the author remarks that of the total battery production of the world over 75 per cent is of the Tudor type. There are 13,000 persons employed in the manufacture of batteries, and the total quantity of lead used is estimated as over 70,000 tons per year.

ELECTRIC PURIFICATION OF WATER.

Dr. G. Erlwein presented a comprehensive report on "Electrical Methods of Purifying Water."

Beginning with a mere mention of the old electrolytic process of Webster and Hermite, he briefly outlined the chlorine process and described the modern methods of water treatment with hypochlorites prepared in electrolyzers, such as that of Kellner or that of Siemens & Halske. The author then took up the two methods which now possess the greatest practical value in sterilization of drinking water, namely, the ozonization process and the ultra-violet radiation process.

Taking up the ozone process first, the author reviewed the chemical and physical properties of ozone, with special reference to its action on different disease microbes. He then described commercial forms of sterilizers that utilize these principles and gave practical results attained in plants installed in various large cities of Europe.

The author next gave the results of tests with quartz-tube mercury-vapor lamps and described the construction of several commercial forms of mercury-vapor sterilizers, giving the energy consumption per cubic meter of water treated.

In conclusion the author compares the ozone and the ultra-violet-ray processes as to bacteriological effects and energy consumption.

ELECTRICAL PRODUCTION OF STEEL.

In a paper entitled "The Direct Production of Steel from the Ore by Means of Electric Furnaces," Mr. Remo Catani briefly reviewed results attained with the furnaces that have been tested under actual operative conditions.

Before taking up the electric processes the author outlined the non-electric processes now in use and gave data on the amount of materials consumed. The following electric furnaces were included in the discussion: Stassano (1898); Chaplet-Néo Métallurgie (1909); Lash (1908); Roechling-Rodenhauser (1910). In studying these furnaces the author tabulated the material and energy required to produce a ton of metal, the calculations having been made from data given by the respective inventors. From this table there was compiled another table giving the itemized cost of the various materials, the energy and the labor required for the production of a ton of steel by each of these different processes.

The total costs per ton of steel were as follows: Stassano with 65 per cent ore, 121.5 lire; Stassano with 48 per cent ore, 183.41 lire; Chaplet-Néo Métallurgie, charcoal, 105.0 lire; Chaplet-Néo Métallurgie, anthracite, 92.75 lire; Lash, 104.75 lire; Roechling-Rodenhauser, 91.15 lire. In conclusion the author said:

(1) All electric furnaces used thus far utilize solely the thermal effect of the current but not the electrolytic effect. The latter phenomena should be studied.

(2) The electric furnaces used for direct production of steel are all of small capacity as compared to the ordinary furnaces—electric or non-electric—used for the production of pig-iron or for the refinement of steel.

(3) The total production of steel by direct electric processes is practically negligible in comparison with that of other processes now in use.

(4) The direct production of steel by electric processes is much more convenient than by any other process.

(5) The quality of the steel is good, especially that of hard steel.

(6) The direct production of steel in electric furnaces does not appear to be more economical than by processes which involve two or three furnaces, one or all of which may be electric or of the ordinary type.

STERILIZATION OF WATER BY ULTRA-VIOLET RAYS.

Dr. M. von Recklinghausen gave an extremely interesting account of the action of ultra-violet rays in the sterilization of water.

He showed how nature keeps micro-organisms under control by the germicide action of the sunlight due to its content of ultra-violet rays.

There are very few artificial sources of ultra-violet rays that have any practical value; indeed, the quartz-tube mercury-vapor lamp is the only source that is adapted to industrial use. In classifying the radiant energy of the ether ultra-violet rays were given as all those of lengths between 0.40μ and 0.10μ. The quartz absorbs all waves below 0.2μ. The earth's atmosphere absorbs all rays up to 0.28μ or 0.3μ. Therefore the living beings of the earth are accustomed to the ultra-violet waves that pass the atmosphere, while waves shorter than 0.3μ, such as are absorbed by the atmosphere, are extremely injurious to them.

In studying the efficiency of production of ultra-violet rays the author found that a 220-volt lamp transformed 6.4 watts out of 100 watts into rays of a length inferior to 0.32μ. When immersed in water this same lamp, owing to the cooling effect, transformed only 0.13 watt per 100 into ultra-violet light. Therefore it is impracticable to immerse the lamp in the water to be sterilized. Lamps which have been in continued use for several years show that after 7000 hours of operation the efficiency is practically unchanged.

In studying the germicide power of the rays it was found that the rapidity of effect of the rays on paper treated with citrate of silver is an exact measure of the sterilizing power, and results of tests were given which showed the effect of distance on the germicide power and the relative vitality of the different kinds of germs. The effectiveness of the rays is greatest in clear water; therefore in industrial plants rapid filters are used to clear the water before subjecting it to the action of the rays.

The author in conjunction with Messrs. Henri and Helbronner developed an apparatus using the Cooper Hewitt quartz lamp. This apparatus handles between 500 and 600 cu. m of water per day of twenty-four hours. There is only one lamp, but the water passes it three times, being automatically stirred all the time. Where more water must be taken care of several of these units are connected in parallel. To prevent the passage of contaminated water in event of failure of the lamp an automatic stop valve is interlocked with the lamp circuit. Several of these plants are now in actual service and more are being installed in various cities in France. They have all been rigorously controlled by microscopic examinations, and in every case have given complete satisfaction.

ELECTRIC STERILIZATION OF WATER AT ROVIGO.

Without any reference to the relative merits of the various electric systems of purifying drinking water, Mr. Luigi de Andreis gave a technical description of the plant recently installed at Rovigo for sterilizing the drinking water taken from the Adige River.

The water of this river has been used for drinking purposes for centuries and has been noted for its purity, and recent analysis showed it still to be perfectly safe to drink under normal conditions. However, it is subject to floods, and at such times the water carries much solid matter in suspension and might easily carry harmful germs. In view of this danger it was thought wise to install a water-purifying plant, and the Siemens-De Frise ozone process was adopted.

The water is taken from the river, decanted, filtered and then sterilized in iron columns, the water falling from the top and the ozone rising from the bottom. The air is delivered to the ozonizers through refrigerating machines.

The energy required for the operation of the plant is derived from a 220-volt distribution circuit, and a reserve unit driven by a 35-hp Diesel engine is provided to avoid shut-down. The drying apparatus, the compressors and the pumps are driven by motors. Motor-generator sets transform 220-volt, 42-cycle energy to 42-volt, 300-cycle energy, and then transformers step the voltage up to 7000, at which tension the ozonizers operate. The plant will handle 1000 cu. m of water in twelve hours, and if necessary can sterilize a much larger quantity.

ELECTRICAL LEGISLATION IN AUSTRIA.

Dr. Heinrich Schreiber in a paper entitled "Legal Regulations for the Generation and Distribution of Electrical Energy in Austria" severely criticised the government of that country for the backwardness of its legislators as compared with the progress of its engineers. He outlined some of the points that should be covered by such laws and made some recommendations.

TAXATION OF CENTRAL STATIONS.

Mr. Mario Bonghi made a comparative study of direct and indirect taxation of electrical properties in various countries and suggested improvements in the present laws of Italy.

The report was discussed by Messrs. Civita, Piazzoli and others.

LOAD-FACTOR IMPROVEMENT.

Mr. G. Sartori submitted a report entitled "Filling in the Load Curve," the data for which were gathered from an extensive canvass of European and American central stations.

In the report the author took up the different kinds of load and discussed their value in improving the load-factor of the system. He distinguished two fundamental methods of accomplishing this result, namely:

(1) To find uses of electric energy which will require energy at times of light load.

(2) To utilize methods of storing energy.

Among the expedients of the first class he discussed the following: Interurban roads with storage batteries to take the peak demands; motor applications; pumping city water; refrigeration; night industries, of which a number were mentioned; irrigation; electrochemical processes; heating and cooking. The development of these various applications has given extremely good results in many cases, and the future for improvement along these lines is very bright.

Methods which involve the storage of energy are not always practicable, and on account of high investment, low efficiency of transformation and expense of operation their advantages are often seriously offset. The storage battery offers the most practical means of storing energy at times of light load. It may be used in the power house, in substations or on the premises of the consumer. The Berlin Elektricitätswerke has successfully introduced this last practice with some of its largest consumers, and gives them special rates at times of light load.

The author also mentioned thermal and hydraulic storage of energy produced at times of light load, but as yet no practical results have been attained along this line.

At the end of the paper the author reproduced the letter and forms sent out for information, and gave values of load-factors and data on load characteristics compiled from the information obtained.

SALE OF ELECTRIC ENERGY.

Under the title of "Rational Methods for the Commercial Measurement of Electric Energy," Mr. Gian-Giacomo Ponti made a general study of the sale of electric energy. He enumerated the factors which enter into cost of electric energy and gave detailed characteristics of production for various kinds of loads at the busbars. After having called attention to the importance of the annual load-factor he made some remarks about the necessity of developing the load-factor, and pointed out the usefulness of special contracts and special apparatus in this direction.

He then named the measuring appliances in most common use, and briefly reviewed the electrical and mechanical characteristics which such energy meters should possess, the errors to which they are subject and the inconvenience

experienced in their operation. The author then briefly discussed laws and regulations in use in various countries for the control of the sale of electric energy, and suggested a number of points which if properly embodied into such regulations would result advantageously to central stations and consumers alike.

A RATIONAL RATE OF CHARGE FOR ELECTRIC SERVICE.

Prof. Riccardo Arnò read a paper on his system of measuring electric service.

There are three factors, each one of which represents energy, namely, the real energy delivered, the energy lost in the line due to Joulean effect of the quadrature current, and the excitation energy necessary to supply the inductive drop. The first is measured by the ordinary watt-meters and the rates are made high enough to cover the other two factors. In ordinary practice the excess energy of excitation is negligible, but the Joulean loss of the quadrature current is not, and therefore it is desirable to devise an equitable means of charging for this energy which is proportional to the volt-ampere-hours. Professor Arnò made assumptions based on average practice and developed an equation which expresses the rate of charge thus:

$$C = \tfrac{2}{3} W + \tfrac{1}{3} W_a,$$

where W is the real watt-hours and W_a is the apparent watt-hours or the volt-ampere-hours.

He then describes a method by which electromotor and induction-type watt-hour meters can be modified to give indications proportional to two-thirds of the real energy and to one-third of the apparent energy.

This system puts a premium on high power-factor and yet involves no extra measuring apparatus and no extra calculation or accounting. In operation it is exactly the same as the straight energy rate.

LEGISLATION ON ELECTRIC TRANSMISSION.

Mr. L. M. Barnet-Lyon limited his paper on the subject of transmission legislation to rights of way, the rights of crossing other public utilities, and responsibility for accidents. He gave a short historical sketch of the development of electric energy transmission, beginning with the demonstration by Marcel Deprez at the electrical exposition in Munich in 1881, where ½ hp was transmitted 7 km. The first successful demonstration of the economic value of energy transmission was made by von Dolivo-Dobrowolski at Frankfort in 1891, when several hundred horse-power was transmitted 170 km at 15,000 volts. The author then showed how the rapid development of electric energy transmission has naturally involved many conflicts, due to interference with telephone and telegraph systems and to danger from high-tension lines, such as are necessary in long-distance work; hence the necessity of legislation. Taking up the question of right of way, the author discussed the laws of Switzerland, France, Italy, Spain and Austria. He then briefly outlined legislation regarding the protection of pre-existing lines from danger or disturbance, and described the laws of Germany, Switzerland, France and Austria. In order to settle disputes satisfactorily and to keep pace with engineering development the author recommended the creation of a technical body which should draft those regulations that require expert engineering knowledge. France and Switzerland have organizations of this kind.

Finally the question of responsibility was taken up and the laws of Switzerland, France and Austria were briefly described.

The paper was discussed by Messrs. Lombardi, Bonghi, Gérard and others.

LEGISLATION ON ELECTRICAL TRANSMISSION.

Mr. E. C. Ericson outlined some of the most important points to be covered by legislation on electrical transmission of energy, namely, safety and control of transmission and distribution lines, responsibility in case of damage, utilization of public highways, control of service furnished to the public, tax on energy, and electrical commissions.

He then briefly reviewed the legislation of Germany, Austria, Belgium, Denmark, Spain, the United States, Finland, France, Great Britain, Italy, Japan, Mexico, Norway, Russia, Sweden and Switzerland. In conclusion the author voiced the following sentiments:

(1) Too little legislation is better than too much.

(2) The state control and supervision of electric systems should be concentrated on the points where it is most needed.

(3) Practical experience should have a reasonable influence in the formulation of laws and rules.

(4) All legislation or lack of legislation which tends to increase the cost of electric energy opposes a very important factor in the development of the industries and comfort of the community.

The report was discussed by Messrs. Gérard, Bonghi and others.

Public Service.

A joint meeting of the Los Angeles Section of the American Institute of Electrical Engineers and the Engineers and Architects' Association of Southern California was held following an informal dinner in Los Angeles, Dec. 19, with an attendance of about 150 members from both societies. The meeting was opened by Mr. Frank A. Wolff, Jr., of the National Bureau of Standards, Washington, who in the course of his remarks said that he intended to report favorably relative to the establishment of a branch of the bureau on the Pacific Coast.

The subject of the evening was "Public Service," which was treated in a paper by Mr. T. B. Comstock, M. E., engineer for the Board of Public Utilities of Los Angeles. The paper dealt with the subject from its first stages, tracing it to the point where the individual, and later the corporation, controlled public utilities owing to the great sums of money involved. Mr. Comstock said that proper and considerate regulation would only be brought about by the engineer, able and well trained, and by a regulating board free from any taint of politics. Mr. Comstock does not believe that municipal ownership will ever adequately fulfil the mission of the private corporation.

Mr. George A. Damon, dean of Throop Polytechnic Institute, Pasadena, spoke of capitalization, over-capitalization, and of funds derived from stock and bond issues and the proper disposition thereof. He said that the time was not far distant when surplus earnings, instead of being used as dividends, would be employed to decapitalize, development cost thus being removed from the capitalization. Mr. Damon believes that the time will come when the seal of the government will be placed upon the securities of public-service corporations to secure the investor.

Mr. R. H. Ballard, of the Southern California Edison Company, entered into the discussion by explaining the real object of a corporation, which is an association of individuals and not an octopus, as the average citizen imagines. Mr. Ballard said that the citizen may think well of the president and the officers of such company and consider the employees "fine," but nevertheless have no use for the corporation. He further stated that placing public utilities under the control of the California State Railroad Commission in the manner now provided might confine that body to regulating service and extensions, a municipal utility board establishing rates.

Prof. C. L. Cory, University of California, pointed out that service is far more important than rates, and that any fair-minded citizen would pay any reasonable charge, even above that now asked, if service were supplied in accordance therewith. Mr. Cory deplored the fact that

the public seemingly will not pay the price that expert engineering talent warrants. He believes that until this feature is improved the fair and consistent regulation of public utilities cannot be brought about.

Mr. O. H. Ensign, chairman of the local section, who presided, spoke of the misappropriation of funds derived from bond sales and the like which had come under his notice, and referred to the short-lived corporation, organized simply for the purpose of robbing the small and unsuspecting investor. Mr. Ensign said that by such operations the reasonably fair corporation was often brought under suspicion.

The meeting was in session four and one-half hours and proved one of the most interesting of the present season. It is planned to hold similar sessions during the winter. The next regular meeting of the local section will be held on Jan. 16, when "Illumination" will be the subject for discussion. Papers will be presented by Mr. E. Y. Porter and Mr. S. B. Lewis.

California Public Utilities Law.

As provided for in the recent amendments to the state constitution passed at a special election in October, a law creating a State Railroad Commission of five members and defining its powers and duties has been enacted by the Legislature at a special session called by the Governor. The bill, technically known as the Railroad Commission act and commonly referred to as the public-utility law, abrogates the Railroad Commission law passed at the last regular session of the Legislature. It was drafted by a committee appointed at the Governor's legislative congress recently held in San Francisco, consisting of Messrs. J. M. Eshleman, president of the State Railroad Commission; Max Thelen, attorney for the commission; Senators L. G. Burnett, L. R. Hewitt and J. W. Stetson; Assemblymen Arthur Joel, C. L. Preisker and W. A. Sutherland. When signed by the Governor, which action is assured, the act becomes operative in ninety days after the adjournment of the special session.

The bill as passed makes use of the wide plenary powers granted the Legislature by the new constitutional amendment. It is modeled after the public utilities measures of New York and Wisconsin, and is said to be even more comprehensive than any of the others in the regulation of state utilities. The State Railroad Commission is increased from three to five members, appointive by the Governor, with an annual salary of $6,000 each. The three present incumbents will serve out the period for which they were elected by the people, and two additional commissioners will be immediately appointed. The power of the commission is augmented to include all public utilities, which term the bill defines as including "every common carrier, pipe-line corporation, gas corporation, electrical corporation, telephone corporation, telegraph corporation, water corporation, wharfing and warehouseman, as those terms are defined in this section, and each thereof is hereby declared to be a public utility."

The commission has the power to fix rates for service, to regulate the standards of equipment and service, to review all stock and bond issues offered for sale, and to see that funds so derived are invested as stipulated. It has the authority to annul bond issues upon evidence of fraud or possible injury to investors, and to prevent over-capitalization. A drastic measure of the bill denies corporations the right of appeal from the commission's ruling on writs of certiorari; it is provided that such appeals may go before the Supreme Court only on questions of law and not of facts, the latter being determined solely by the commission, which may adopt its own procedure in taking testimony and is not governed by rules of evidence.

In the application of street railways a "certificate of public necessity" must accompany a petition. The law provides that municipalities may at a special or regular election vote to retain jurisdiction over the public utilities within the corporate limits. The Legislature appropriates the sum of $210,000 for the use of the State Railroad Commission in carrying out the provisions of the law.

Public Service Commission News.

NEW JERSEY COMMISSION.

The Board of Public Utility Commissioners of New Jersey will hold several hearings next week. On Jan. 2 the board will hear the complaint of the township of Bordentown against the Riverside Traction Company in reference to the refusal of the company to provide reduced-rate transportation for school children and free transportation for certain township officials. The board will also hear the complaint of the Maple Shade Improvement Association against the Public Service Railway regarding the rates of fare between Camden and Maple Shade. On Jan. 3 the board will continue at Newark its investigation into the reasonableness of rates charged by the Public Service Gas Company. On Jan. 5 the board will hear the complaint of Edward J. Dusel against the New York Telephone Company in regard to alleged failure to supply service in the borough of Dunellen.

OHIO COMMISSION.

In the case of Denny Cross against the Central Union Telephone Company the Ohio Public Service Commission has issued a decision to the effect that companies cannot terminate service to subscribers at will, but must frame a set of rules by which to be guided in such action, and that these rules must be incorporated in the contract. Cross complained that the company had "cut out" his telephone on Dec. 18 on the allegation that he had not paid his bill for the month. It developed that the only rule the company had in regard to the payment of bills is that a discount would be allowed if they were paid before the tenth of the month. Failure to pay, however, usually brought a discontinuance of service about the eighteenth of the month, but this was shown to be solely a matter of practice without definite rule or contract as to terms. The company was ordered to restore the service to Mr. Cross pending the settlement of the difficulty over the account and was told that it must put in use a set of definite rules and regulations before it could discontinue service for any cause.

The Circuit Court has reversed the decision of the Common Pleas Court in the case of the Tiffin Art Metal Company against the Tiffin Consolidated Telephone Company, Tiffin, in which the authority of municipal councils to fix rates for service was brought into question. The decision of the higher court is to the effect that this authority does not extend to fixing rates under the public-utilities act passed by the last Legislature. This decision follows similar findings made several years ago so far as the authority of municipal councils is concerned. The case originated in an ordinance passed by the City Council of Tiffin on Oct. 4, by which a material reduction from the old rates was made. The ordinance was ignored by the telephone company, and the Art Metal Company instituted suit in Common Pleas Court asking for an injunction, which was granted. The case was then carried to the Circuit Court. The telephone company some time ago filed a petition with the Public Service Commission asking for a hearing on its schedule of rates to determine whether they are reasonable and to prevent the city from enforcing the ordinance. This is still pending, and the company is under bond of $30,000 to guarantee a rebate should the lower rate be decided upon by the commission.

MARYLAND COMMISSION.

The Maryland Public Service Commission has held a hearing in the case of the Consolidated Gas, Electric Light & Power Company against the Paper Mills Company, arising out of the controversy between the two companies about charges of electricity. The Paper Mills Company asserts that it was assured by the Gas & Electric company that its bill would not exceed $100 a month and refused to pay more than that. The Gas & Electric company said there was no such agreement, though it had been estimated that the bills would not exceed that amount, and contended that to allow a flat rate of that amount would be to make a discriminatory rate in favor of the Paper Mills Company, which was forbidden under the Public Utilities act. The commission gave no decision in the case.

Mr. Charles E. Phelps, chief engineer of the commission, reports a valuation of the property of the Chesapeake & Potomac Telephone Company in Baltimore city as follows: Land and buildings, $810,973.38; exchange equipment, $1,203,929.99; subscribers' equipment, including installation, $781,414.30; underground conduits, $1,142,839.97; pole lines and distribution, $196,225.74; underground cables. $917,340.40; interior block district, $108,704.67; aerial wire, $314,445.52; aerial cable, $198,089.24; rights-of-way, $28,231.22; total, $5,702,194.43; miscellaneous property. $79,162.45; gross capital investment, $5,781,356.88; depreciation for four months, at rate of 5.95 per cent yearly, $113,714.78; net capital investment as of April 1, 1911, $5,667,642.10; depreciation for four months at rate of 6 per cent yearly, $115,627.14; net capital investment as of April 1, 1911, $5,665,729.74. The figures given above were taken as of Nov. 30, 1910. As the valuation was as of April 1, 1911, there was a depreciation of four months to be deducted. The rate of depreciation figured is 6 per cent per annum, making the rate for four months 2 per cent. Investigation by the commission's experts of the figures from the company as to cost, charges and service is steadily progressing.

Baltimore city has directed Deputy City Solicitor Alexander Preston, formerly associate counsel for the Consolidated Gas, Electric & Power Company, to devote his entire time to the case to come before the Public Service Commission relating to rates for electricity and gas. It was explained by Mr. W. Cabell Bruce, of counsel to the commission, that the commission and its counsel would act at the hearing as potential prosecutors. That is, if the commission had questions that were not asked of witnesses by the city solicitor, then the commission itself would ask them.

Chairman Ambler of the commission has been selected to succeed Judge Niles, who recently resigned from the Supreme bench, and it is the general belief that Commissioner Phillip D. Laird, whose regular term expires next May, will be named as his successor. If a new man were appointed to Mr. Ambler's place it would probably delay the settlement of the investigations now under way, as at the expiration of Mr. Laird's term next May the Republican Governor will in all likelihood name a Republican in his place, thus leaving Dr. Hering, the layman of the commission, as the only member who had followed pending cases through their entire course. Mr. Laird has been probably the hardest worker of the members, and by many is considered peculiarly adapted to his duties. He is a man of broad learning, a deep student and possesses a strongly analytical mind. The names of Mr. Marion V. Brewington, of Wicomico County, who was mentioned for appointment at the time the present commission was named, and Mr. William Cabell Bruce, at present general counsel to the commission, have also been mentioned. If a Republican is to be named it is believed that the place will first be offered to Mr. Morris A. Soper, for whom Governor Crothers has expressed high admiration. It is presumed that Mr. Goldsborough also would gladly welcome the opportunity of acknowledging Mr. Soper's services to his party by renaming him in May.

NEW YORK COMMISSION.

The hearing on the complaint made by certain organizations of stationary engineers that the New York Edison Company gives discriminatory rates to large customers was resumed Dec. 26 before Commissioner Maltbie of the Commission for the First District. The complainants had again secured counsel, and the latter called the general auditor of the New York Edison Company, who was examined as to the compiling and meaning of certain parts of the annual reports of the company. The next hearing is scheduled for Jan. 3, 1912, at 2:30 p. m.

CURRENT NEWS AND NOTES.

CAR-LIGHTING 60-VOLT STANDARD.—The Harriman lines, the Chicago & Northwestern and the Northern Pacific railroads have decided to adopt 60 volts as the standard for car lighting.

* * *

COLORADO ELECTRIC CLUB.—At the Thursday luncheon of the Colorado Electric Club on Dec. 21 an unusually large attendance, 194, listened to a strong plea for the grand jury system by ex-Senator T. M. Patterson, owner of the *Denver News*. The club will give a New Year's ball and entertainment in the banquet hall of the Brown Palace Hotel, Denver, at 8:30 p. m., Dec. 29.

* * *

COMMONWEALTH EDISON SECTION OF N. E. L. A.—In carrying out its policy of inviting men prominent in public-service affairs to address it, the Commonwealth Edison Section of the National Electric Light Association will listen to Mr. L. C. Fritch, chief engineer of the Chicago Great Western Railroad, on Jan. 3, at Association Hall, 19 South LaSalle Street, Chicago. Mr. Fritch's subject will be "The Chicago Railway Terminals."

* * *

LUNCHEON CLUB FOR BOSTON.—A luncheon club was started in Boston Wednesday, Dec. 20, at the Hotel Thorndike. The New England Section of the National Electric Light Association, together with several electrical manufacturers and supply men, has been instrumental in getting the club started, but it will be composed of members of all lines of the electrical industry. It is the intention to arrange to have a speaker of prominence at the luncheons, which will be given weekly.

* * *

PRESIDENT TAFT'S REFERENCE TO ILLINOIS-MISSISSIPPI WATERWAY.—In his message to Congress of Dec. 21 President Taft said that the project for a navigable waterway from Lake Michigan to the mouth of the Illinois River and thence, by way of the Mississippi, to the Gulf of Mexico is one of national importance. He speaks of the Chicago Drainage Canal, connecting the Chicago River with the Desplaines River, which in turn flows into the Illinois River, as an asset of the nation. In view of the fact that the people of Illinois have authorized the expenditure of $20,000,000 to carry this waterway 62 miles farther, to Utica, Ill., the head of navigation on the Illinois River, the President thinks that this work should be supplemented by the national government. He recommends that the term of service of the special board of government engineers which has studied this project be continued, and that it be empowered to negotiate with the State authorities, with the idea of constructing the navigable waterway from Lockport, Ill., to the mouth of the Illinois River. The project is of interest to electrical men, in northern Illinois particularly, because of the hydroelectric possibilities of such a waterway, if constructed.

Wichita (Kan.) Municipal Lighting Plan Defeated.—At a special municipal election held recently at Wichita, Kan., a proposal for the erection of a municipal electric-light plant was defeated by a vote of 2345 to 790.

* * *

Gas-Engine Central Stations.—In a recent paper read before a gas-engine association Mr. Rossiter Holbrook stated that there is over 60,000 hp from gas engines in the central stations of this country, and that there are over 170 central-station gas-producer plants in England.

* * *

Tests of Meters.—Of 6309 tests of meters made by the New York Public Service Commission, Second District, in September, 1911, 333, or 5.28 per cent, were fast; 5089, or 80.66 per cent, were accurate, and 887, or 14.06 per cent, were slow. Of 237 companies 41 did not report, and, of the remainder which reported, 103 made no tests.

* * *

Brooklyn Company Section, N. E. L. A.—At the meeting of the Brooklyn Company Section of the N. E. L. A. to be held at the Johnson Building Jan. 8, 1912, the speakers will be Mr. T. I. Jones, whose topic will be "Development of Our Business During 1911," and Congressman W. C. Redfield, who will speak on "Industrial Contracts Here and Abroad."

* * *

New York Edison Company Founds a School.—The New York Edison Company has established a school for the education of the 512 employees who constitute its contract and inspection department. It opened on Dec. 27 in the Edison Auditorium. The plan follows the general lines of the educational system started by big business enterprises, especially in Germany, to teach employees business details and fit them for promotion. The term will be for six months and the class sessions will be held daily except Friday between 4 and 5:30 p. m.

* * *

Isolated Electric Plants.—In a paper presented by Mr. Rossiter Holbrook before the annual meeting at Cleveland on Dec. 6 of the National Gas Engine Association it is stated that in fifteen of the principal states, which were mentioned by name, there is 5,544,888 engine horse-power in isolated electric plants, with which is contrasted the United States Census figure of 4,862,921 for the total horse-power of the central stations of the United States. It is stated that the isolated plants of Ohio aggregate over 800,000 hp, and those of Cleveland over 390,000 hp.

* * *

New York Jovian Lunch Club.—At the luncheon of the Sons of Jove held in New York Dec. 27 there were 152 in attendance, this being the largest number present at any of the luncheons thus far. The speaker on this occasion was Mr. T. C. Martin, secretary of the National Electric Light Association, who spoke on "Co-operation in the Electric-Lighting Field." Mr. Martin told of the benefit of the co-operative get-together methods of the association both to the lighting companies and to the general public, and which had led to an increase of the membership of the association from a little over 3000 three years ago to over 10,000 at the present time.

* * *

Platinum Consumption and Production in United States.—According to Mr. Waldemar Lindgreen, of the United States Geological Survey, the placer mines in Oregon and California, from which the entire output of crude platinum in the United States is recovered, produced 390 troy ounces of platinum, valued at $9,507, in 1910, against 673 oz., valued at $12,803, in 1909. A considerable quantity of refined platinum, estimated to be 4800 oz., valued at $156,960, is produced from imported crude platinum, the largest part of which comes from Colombia and Russia. The total output of refined platinum in the United States, of both domestic and foreign origin, was about 5573 fine ounces, valued at $182,237.

* * *

Philadelphia Section, I. E. S.—At a meeting of the Philadelphia Section of the Illuminating Engineering Society held on Dec. 15 a paper on institutional lighting was presented by Dr. W. M. L. Coplin, medical director of the Jefferson Hospital and professor of pathology, Jefferson Medical College. The author has made a thorough study of the problem of correct and efficient illumination, especially of wards and operating rooms in hospitals, both here and abroad, and a great many new ideas in regard to what is required in hospital lighting were obtained from him. The paper was discussed by Dr. William Spitzka, Professor Hoadley, of Swarthmore College, and Messrs. C. B. Regar, C. O. Bond, F. N. Morton and G. B. Muth. The attendance totaled 139 members and guests.

* * *

Tests of a Suction Gas Producer.—Bulletin No. 50 of the engineering experiment station of the University of Illinois gives the results of twenty-five tests made on a small suction gas producer for the purpose of obtaining data on the efficiency, reliability and operation of suction producers of small size using anthracite as a fuel. The theory of gas producers is discussed at some length. The conclusion is reached that a producer of the above type is a practical piece of apparatus for a class of work not requiring close regulation; also that the percentage of CO_2 in the gas can vary within wide limits without affecting the efficiency of operation. A very complete set of forms for reporting tests has been drawn up, and the formulas for calculating the trials have been deduced.

* * *

Philadelphia Electric Company Section, N. E. L. A.—At the meeting of the Philadelphia Electric Company Section of the N. E. L. A. Dec. 18 Mr. A. H. Armstrong, of the General Electric Company, gave an interesting talk on "The Coming of the Electric Locomotive." During the month the commercial and meter department branches held meetings, the former being addressed by Mr. C. J. Russell, who spoke on "Corporations," and the latter being addressed by Mr. E. L. Kyle, who read a paper on the "errometer." The instrument is essentially of the high-speed, motor-driven recording type, having a multiplicity of siphon pens operated by electromagnets, and is used for determining the accuracy of the various methods of meter testing. It was constructed by the meter department of the Philadelphia Electric Company.

* * *

Panama Canal Drydock to Be Electrically Operated.—Plans for the completed Panama Canal include a large graving dock, or drydock, which will be located at Balboa, at the Pacific entrance to the canal. The design of the dock has been placed under the immediate charge of Canal Commissioner H. H. Rousseau, civil engineer, U. S. N., who has recommended a dock with a length sufficient to receive vessels 1000 ft. in length, with a clear width at the entrance of not less than 110 ft. and a depth of 39 ft. over the sill, as compared with mean sea level. Miter gates of design similar to the miter gates of the Panama Canal locks are recommended for the drydock. These gates will be operated by electric motors. Along each side of the dock will be tracks for a 40-ton locomotive crane, and the dock will be provided with the usual capstans, electrically operated. The pumping plant will consist of not less than three vertical centrifugal pumps of large size and two small drainage pumps. These will be driven by electric motors, and energy will be obtained, no doubt, from the hydroelectric plant at Gatun. Repair shops equipped with electrically operated machine tools will be placed alongside the drydock.

HYDROELECTRIC ENERGY FOR IRRIGATION.

Minidoka (Idaho) Federal Project, Utilizing 10,000-hp for Electric Pumping.

Water for Irrigating 48,000 Acres Lifted 66 ft.—Detailed Cost of Construction and Operation of Generating Plant, Transmission Lines and Pumping Stations—Energy Sold for Heating at 0.14 Cent per Kw-hour and for Lighting at 7 Cents per Kw-hour.

THE development of irrigation in Idaho has reached a state such that the desirable lands which can economically be reached by gravity ditches are now nearly all covered. In many cases, too, the upper benches, when watered, are even more valuable from an agricultural standpoint than the lower gravity lands.

On the Minidoka Project in southern Idaho the United States Reclamation Service has in operation the largest pumping system that has been undertaken. Here water is pumped for approximately 48,000 acres, the average lift being 66 ft. Mr. Barry Dibble, electrical engineer, United States Reclamation Service, in charge of the Minidoka power and pumping system, presented a paper describing the electrical equipment of the completed project before the Idaho Society of Engineers at Boise, Nov. 25, from which address the present account is abstracted.

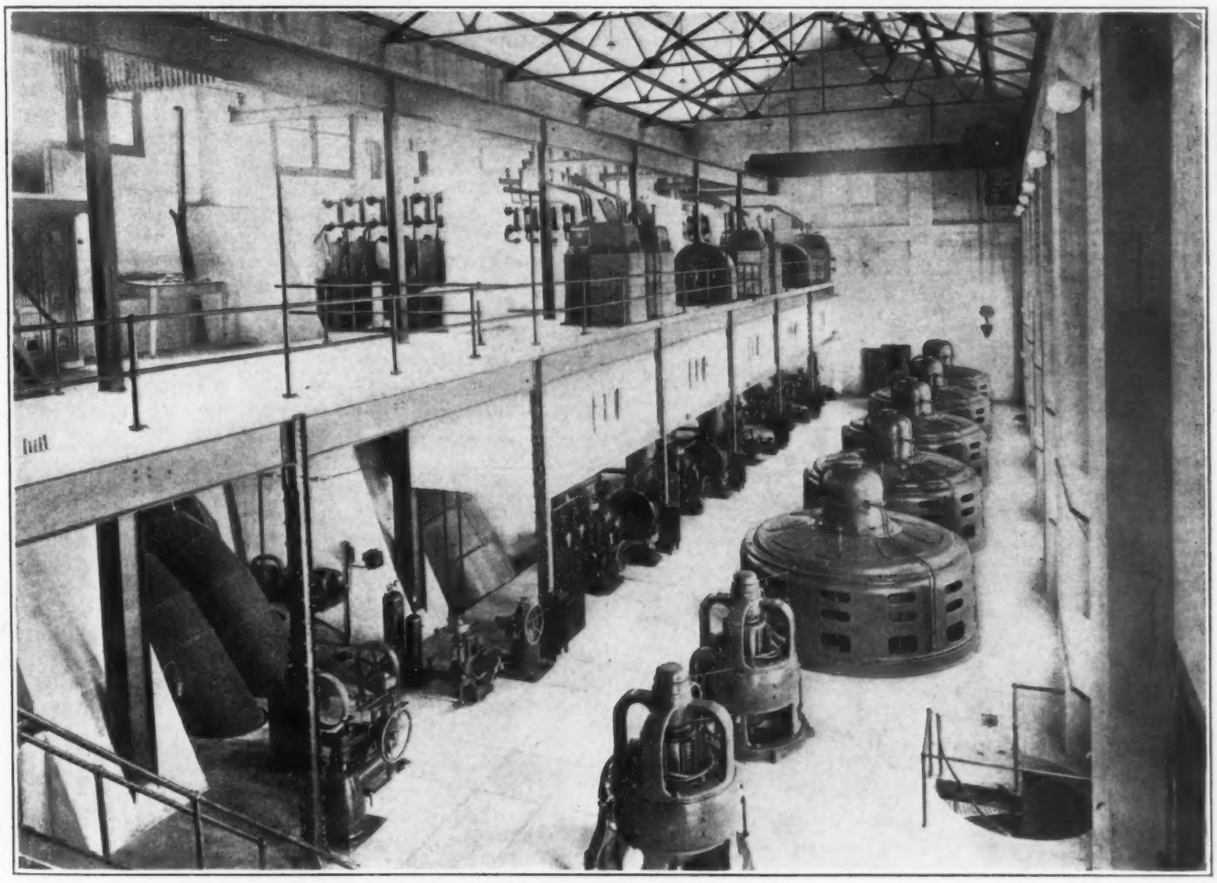


Fig. 1—Main Generator Floor and Transformer Gallery, Minidoka Power House.

POWER PLANT AT MINIDOKA.

The Minidoka Project, as a whole, takes water from the Snake River at the diversion dam near Minidoka. This dam is about 50 ft. in height and forms a backwater known as Lake Walcott, which at the level of the spillway crest covers approximately 10,000 acres and holds 53,500 acre-ft. About 200 miles further up the river is the Jackson Lake storage reservoir, the water from which is used during the low stage of the river.

At the diversion dam is located the hydroelectric plant which supplies the power required for pumping and for other purposes about the project. The development uses just about the minimum flow of the river, to which there are prior claims below, so that the water must be allowed to pass downstream.

The power house is a reinforced-concrete structure with steel roof trusses and purlins covered by matched lumber and galvanized corrugated iron. It measures 149 ft. long by 50 ft. wide and 90 ft. high from the bottom of the tailrace to the peak of the roof. It contains five main generator units of the vertical type, each of 2000-hp rated capacity, and operating under heads of 46 ft. from forebay to tailrace. There are also two 180-hp turbine-driven exciters.

Each main unit consists of a single Francis runner, 54 in. in diameter, operating at 200 r.p.m., direct-connected to a 1400-kva, three-phase, 2200-volt generator. The weight of the rotating parts is supported from a thrust bearing mounted above the generator and consisting of two cast-iron disks in a water-cooled oil bath, the oil being circulated by vanes cut on the rotating face.

Each generator is directly connected to a three-phase air-blast transformer which has a step-up ratio of 2300 volts to 33,000 volts. The 33,000-volt side of the transformer is star-connected, its neutral point being grounded. There are no 2200-volt power-house buses, each turbine with its generator and transformer operating as an independent unit, while all switching is done from the 33,000-volt side. Here each transformer feeds out through disconnecting and oil switches to one of two sets of busbars. Either bus can

be connected, through disconnecting and oil switches, to either one of the two outgoing transmission lines. At the power plant each transmission line is provided with a bank of electrolytic lightning arresters designed for 19,000 volts from line to ground.

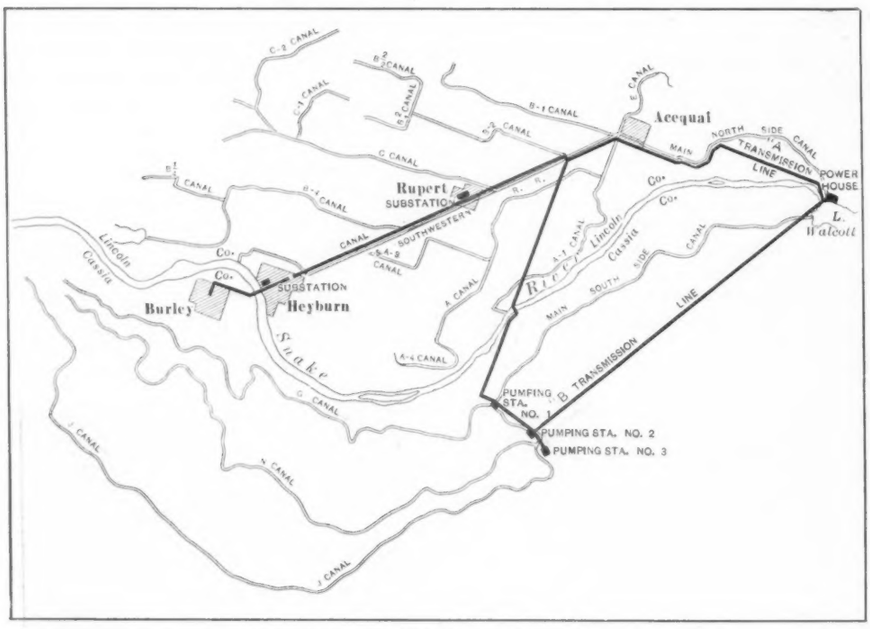


Fig. 2—Map of Minidoka Project, Idaho.

POWER HOUSE. CAPACITY, 1000 KW.

	Total Cost.	Per Kilowatt.
Building	$82,000	$11.70
Hydraulic machinery	73,000	10.40
Electric machinery	83,000	11.80
Freight and hauling	26,200	3.75
Erection	55,500	7.90
Tailrace	60,000	8.50
Roads and telephone lines	7,300	1.40
Camp and permanent quarters	23,200	3.30
Engineering and incidentals	11,100	1.55
Administration charges, etc	15,000	2.10
Total	$433,300	$62.40

The power house is now completed, and in round figures the cost of the plant and its accessories is as shown above.

TRANSMISSION LINE "B."

	TOWER-LINE COST.		POLE-LINE COST.	
	Total.	Per Mile of Line.	Total.	Per Mile of Line.
Surveys and location	$18	$36	$175	$17
Clearing 100-ft. right-of-way	....	....	356	34
Pole and tower line complete, except conductors:				
Material	1,035	2,070	2,129	203
Freight and hauling	255	510	1,333	127
Labor	803	1,606	1,685	161
Conductors (transmission and telephone):				
Material	610	1,220	2,655	253
Freight and hauling	83	166	557	53
Labor	75	150	670	64
Superintendence and clerical	18	36	200	19
Miscellaneous	40	80	397	38
Engineering	23	46	220	21
Total	$2,960	$5,920	$10,377	$990

TRANSMISSION LINES.

The transmission system consists of 38.4 miles of 33,000-volt line. Of this 29.7 miles, costing $34,000, is required for the pumping system. One line extends down the north side of the river and furnishes power to several towns on the project. The second line has been built direct to the pumping stations, a distance of 11 miles across country. A tie line also connects the first line to the pumping stations. The ordinary spans, varying from 175 ft. to 250 ft., are carried on wooden poles, and at the river crossings spans varying from 700 ft. to 1100 ft. are supported on steel towers. The new construction is borne on heavy poles 35 ft. to 45 ft. in length, spaced 250 ft. apart. Each of the three copper conductors is a hard-drawn three-strand cable equivalent to No. 5 B. & S. in cross-section.

Herewith is given the cost of the line built in the last season direct from the power house to the second pumping station. It crosses the river just below the spillway, on five steel towers, 49 to 57 ft. high, with spans of 800 ft. and sag allowances of 35 ft. On the towers seven-strand copper cable is used, equivalent to No. 2/0 in cross-section. The towers themselves are erected on concrete foundations on small rock islands. The locations are difficult of access and this made the delivery of material expensive. The rest of the line is a tangent across a rolling country for a distance of 10½ miles on heavy cedar poles, as described above. On this section either rock or hard pan was encountered at an average depth of 2 ft. below the surface, and 95 per cent of the holes were drilled and shot. The pole holes alone cost on the average $3 each.

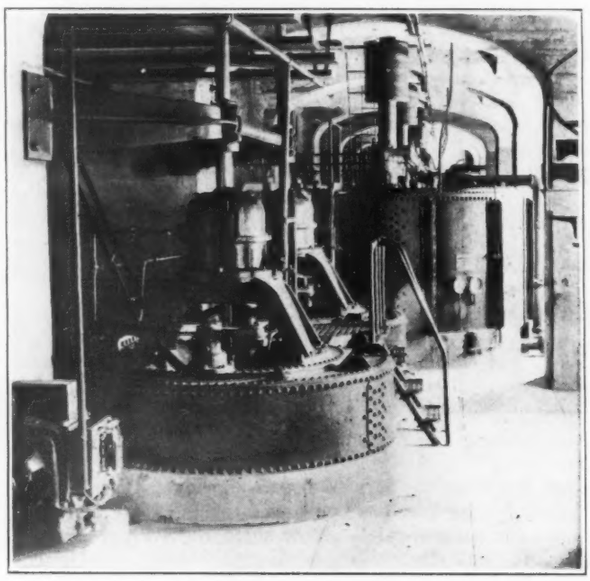


Fig. 3—Exciter and Alternator Water Turbines Below Generator Floor.

PUMPING STATIONS.

There are three pumping stations, the first located at the end of the gravity canal and lifting the water to the first level, the second about 1.75 miles distant, lifting a portion to the second level, and the third, another 0.75 mile distant,

raising a final portion to the third level. The first station has a maximum capacity of 600 cu. ft. per second at normal speed. The lift at this station and at each of the others varies from 30 ft. to 31 ft. The stations are of the same general design and a description of the first will in general apply to all.

The buildings are of reinforced concrete with concrete roofs. The first is 140 ft. long by 18 ft. and 30 ft. wide and

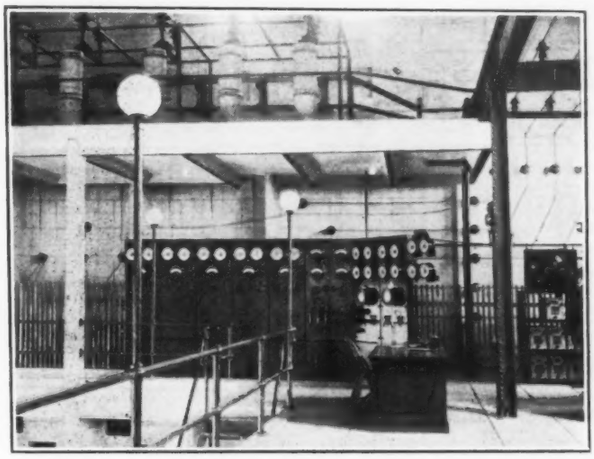


Fig. 4—Switchboard and Lightning Arrester.

45 ft. high. It contains four pumping units, each delivering 125 cu. ft. per second, and one delivering 75 cu. ft. per second. Each pump is located in an independent concrete chamber 17 ft. x 16 ft., protected by steel trash racks and steel gages. The pumps are of the vertical-shaft type and have both top and bottom suction. The impellers are 44 in. in diameter and run at 300 r.p.m. When starting a unit the pit gates are lowered and the pit is pumped out, thus reducing the power required from the motors. When operating the pump is submerged in the water. The discharge is controlled by a cylinder gate between the impeller and diffusion vanes, the pumps discharging through a tapered casting into a reinforced-concrete pressure pipe 5 ft. 6 in. in diameter. At the discharge end each pipe is closed by a steel-plate flap valve, which floats on the water when the pump is operating.

Each pump is driven by a 600-hp, three-phase synchronous motor, wound for 2200 volts and provided with auxiliary squirrel-cage windings to increase its starting torque. At starting 600 volts is applied to the motor armature, with the field coils short-circuited. The motor is brought up in this way to nearly synchronous speed as an induction motor, and then the field switch is closed and the motor is automatically synchronized at low voltage. It is then thrown on to the 2200-volt buses.

Originally a small pump delivering 1 cu. ft. per second was provided for emptying the pump pits. This pump took forty minutes to empty one pit, interposing at least this interval between starting successive pumps. To get the pumps back on to the line in rapid succession, a discharge pipe with a valve has been fitted to the manhole of each pump, the pump being thus made to clear its own pit. Before a unit is started this 18-in. valve is opened. Then the unit is started as before and the pit is pumped out while the pump is running at slow speed. As soon as the water level has fallen the pump speeds up and can be synchronized. As the result it now takes only two minutes from the time the pump is started until it can be thrown on to the line, ready for raising the pit gates and beginning pumping. The actual interval between starting successive pumps is about ten minutes, with one operator to perform all the work.

The 30,000-volt transmission lines enter the pumping station through disconnecting switches, to a single set of 30,000-volt busbars. From this bus disconnecting and oil switches lead to five 500-kw air-blast step-down transformers feeding a common 2200-volt bus.

The second pumping station contains four pumps, each rated at 125 cu. ft. per second. Here the transformers for the third station are also installed, together with the shop equipment for all the stations and the principal camp for the operators. At the third lift are two 125-second-ft. and one 75-second-ft. pumping units. At present the last pump in each station is being installed.

The final total pumping-station costs will be about as follows:

PUMPING STATIONS.

	Number 1.	Number 2.	Number 3.
Excavation	$2,100	$5,300	$2,000
Building	35,000	40,000	19,500
Hydraulic machinery	27,200	23,000	16,200
Electrical machinery	44,700	42,800	17,300
Freight and hauling	10,300	9,600	5,500
Erection	15,800	14,600	9,300
Camp and permanent quarters	4,000	11,000	500
Engineering and inci lentals	5,000	3,000	2,000
Administration charges, etc	8,500	7,000	5,500
Total	$152,600	$156,300	$77,800
Capacity—cubic feet per second	575	500	325
Cost per second-foot capacity	$265.40	$312.60	$239.40
Pressure pipes, including administration charges	$21,400	$16,500	$20,200
Total length of pressure pipes—feet	849	540	825
Cost per foot	$23.90	$30.30	$24.50
Cost per second-foot of capacity, including pressure pipes*	$303.00	$346.00	$301.00

*Average, $318.00.

OPERATION OF THE SYSTEM.

In testing the waterwheels at the plant the size and the water necessary to operate them made it impracticable to measure the flow in the ordinary way. A frame flume 40 ft. long with a submerged cross-section of 120 sq. ft. was accordingly constructed, floated in front of the trash racks, and loaded with anchors to hold it in place. The water flowing through the flume was then measured with current meters, the quantities varying from 250 cu. ft. to 507 cu. ft. per second.

The operation of the entire system has been very satisfactory. There have, of course, been minor troubles to be eliminated, but these are gradually being disposed of, and each year shows more satisfactory results than the previous one. The load has been increasing very rapidly. When it was determined to install the final pumping units in each of the pumping stations it was intended that this should be reserve capacity. It is now thought, however, that all the

Fig. 5—Forebay of Pumping Station No. 1.

units will be required during the height of the irrigation period, at least until the settlers learn to use the water economically.

The accompanying curves, Fig. 7, show in a general way the distribution of the load throughout the year. During the period of heavy load the daily average practically equals the maximum, resulting in a yearly load-factor of 35 per cent. Besides the pumping load, electrical energy is

furnished to several towns on the project. Of course these are small as yet, but their motor-service demand is rapidly increasing, and low rates are made to encourage this business. The retail electrical heating business in particular is given the very low flat rate of $1 per month for each kilo-

EFFICIENCY OF APPARATUS.

	Full-Load Efficiencies, per Cent.	Net Efficiency from Water Behind the Dam, per Cent.
Turbines	81.5	81.5
Generators	96.0	78.2
Step-up transformers	98.4	77.0
Transmission line	90.0	69.3
Step-down transformers	98.0	67.9
Motors	94.0	63.8
Pumps	72.5	46.3

watt of connected capacity. If used continuously this is equivalent to 0.14 cent per kw-hour. Lighting is given a rate of 7 cents per kw-hour, with a further reduction for consumption over 25 kw-hours per month. In the one year since this commercial business was begun the gross annual income has been increased to $12 per inhabitant, in spite of the low rates charged, and the future is very encouraging. The plant is kept in operation all winter for this load.

In figuring the annual cost of operation to be charged to the pumping system this commercial service is allowed for. It is apparent, however, that there would be considerable expense to maintain the station, requiring a watchman and repair crew, even though the plant were not operated during the winter. Therefore, one-half of the winter operating cost is charged to the pumping system. At all the stations and on the transmission line operation is carried on at high pressure during the summer, with the expectation of thoroughly overhauling all the equipment between seasons. This makes it possible to cut down the operating force to a minimum, besides keeping a considerable portion of this force busy the year round, with obvious advantages to the organization.

At the station the regular operating crew consists of two men, one in general charge of the power station operating the switchboard, and a helper to take care of the machinery and watch the bearings. A foreman is in charge of the operation of the power house. On the transmission line one

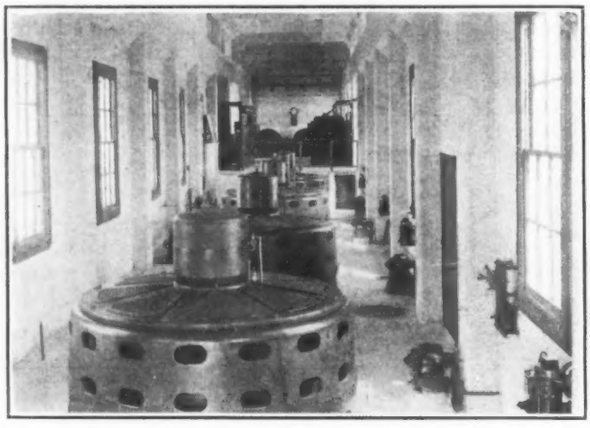


Fig. 6—Interior of Pumping Station No. 1.

man is able properly to patrol the entire system and do other work besides. During the pumping season all the transmission lines are patrolled twice a week. At each pumping station there is one man on each eight-hour shift, making nine regular operators. These men are under a foreman, who has a helper to use on miscellaneous work around the stations. The men are paid comparatively high wages, considering that their work is on an eight-hour basis, but in return they are expected to give more than usual attention to the work and to keep the stations in first-class condition.

UNIT COSTS OF OPERATION.

Cost of operation depends on many conditions. The cost at Minidoka during the past year has been very low, but it

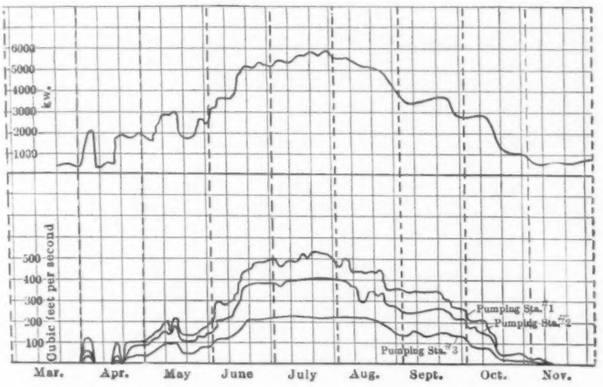


Fig. 7—Yearly Curves of Station Demand and Water Pumped.

might be increased at any time by a serious accident to an important piece of machinery. It is here that intelligent and alert operators can make themselves worth a good salary by catching the troubles before they develop to a serious extent.

The depreciation of equipment is an important item, although often overlooked. In the following table a rate of depreciation of 5 per cent per annum has been applied to the stations and 10 per cent to the transmission lines. No interest is included, as the money for the work comes from the reclamation fund, which is practically loaned to the settlers without interest. In the table allowance for repairs, etc., has been increased over that so far needed, as this item will undoubtedly increase with time. It is not intended to include the item of depreciation in the annual charge made against the settlers. However, this item will have to be met as time goes on and the machinery wears out. This can be done by paying for replacements as they are needed, and in the meantime the settlers will have the use of their money, which is worth 10 to 12 per cent interest, whereas if the government collected a depreciation fund it would have to hold it without interest.

OPERATION AND MAINTENANCE OF POWER AND PUMPING SYSTEMS.

	Power House.	Transmission Line.	Pumping Stations. No. 1.	Pumping Stations. No. 2.	Pumping Stations. No. 3.	Total.
Operation:						
Labor	$5,700	$700	$2,100	$2,100	$2,100	...
Supplies	950	100	200	200	150	...
Repairs:						
Labor	900	600	600	600	400	...
Supplies and material	300	100	100	100	80	...
Superintendence, clerical, camp, etc	1,700	200	700	700	500	...
General expense and administration	450	50	150	150	100	...
Total operating expense	$10,000	$1,750	$3,850	$3,850	$3,280	$22,730
Depreciation	21,700	3,400	7,600	7,800	3,900	44,400
Total	$31,700	$5,150	$11,450	$11,650	$7,180	$67,130
Annual cost per acre, including depreciation	$0.660	$0.108	$0.239	$0.243	$0.150	$1.40
Operating expense per acre (48,000 acres)	0.208	0.037	0.081	0.081	0.068	0.475

During the season of 1911 114,000 acre-ft. of water were pumped to the average height of 66 ft., equivalent to 7,560,000 acre-ft. lifted through 1 ft. The operating cost for this pumping was about $0.003 per acre-ft. lifted through 1 ft., and the depreciation amounted to $0.006. Next year more water will be pumped at practically the same total cost, and therefore the unit cost will be reduced.

SUMMARY OF INSTALLATION COSTS.

Power house and accessories	$433,300
Transmission line	34,000
Pumping stations with pressure pipes	444,800
Total investment on power system	$912,100
Investment per acre (48,000 acres)	$19.00

SUMMARY OF ANNUAL CHARGES.

Operation	$22,730
Depreciation	44,400
Total	$67,130
Per acre (48,000 acres)	$1.40

A total of 14,000,000 kw-hours was delivered to the pumping stations during the year at a cost of $37,000, including depreciation, or $0.0026 per kw-hour. If, as would be necessary in the case of a commercial company, interest, taxes, etc., amounting to, say, 10 per cent on the investment in the power house and transmission line, were added, the cost would have been perhaps $0.006 per kw-hour.

INDUCTION MOTOR DESIGN CONSTANTS.

A Simplified Algebraic Expression of Theoretical Relations and Empirical Constants Applicable in Designing Standard Induction Motors.

BY A. MILLER GRAY.

IN what follows there will be described a method whereby the principal dimensions of an induction motor, and also its characteristics, may be determined with a minimum amount of labor. The method should be of interest to designers in general and particularly useful to estimating engineers on induction-motor work.

The fundamental formula used in the design of electrical machinery is that which connects the output with the diameter and length of the machine, namely,

$$C = \frac{hp}{r.p.m. \times D^2 L} \qquad (1)$$

where C is called the output factor.

This formula is derived as follows:

$$E = 2.22\, k_1 Z \Phi f\, 10^{-8}$$

$$hp = nEI\,(\cos\Theta)\,\eta_1 = n\,(2.22 k_1 Z \Phi f\, 10^{-8})\, I\,(\cos\Theta)\,\eta_1$$

$$= n \times 2.22\, k_1 Z B \tau L \frac{r.p.m. \times p}{120}\, 10^{-8}\, I\,(\cos\Theta)\,\eta_1$$

from which

$$\frac{hp}{r.p.m. \times D^2 L} = B \times q \times 2.36 \times 10^{-12} \cos\Theta \times \eta_1 = C \qquad (2)$$

In the above equations and in those developed below the symbols have the following significance:

B = average flux density in the air-gap $= \frac{\Phi}{\tau L}$ lines per square inch.

D = rotor diameter in inches.

E = effective emf per phase in volts.

hp = horse-power output.

I = full load current in amperes.

I_o = magnetizing current in amperes.

I_D = ideal short-circuit current (see Fig. 7) in amperes.

L = length of gross stator iron parallel to shaft in inches.

$r.p.m.$ = synchronous speed in r.p.m. $= \frac{f \times 120}{p}$

V = peripheral velocity of rotor in 1000's of feet per minute.

Z = conductors in series per phase.

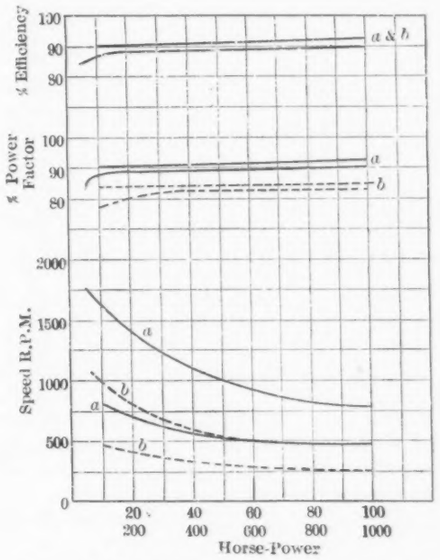


Fig. 1—Efficiency, Power-Factor and Speed.

a = conductors per phase per pole.

b = conductors per slot.

k_1 = distribution factor = 0.96 for three-phase and 0.91 for two-phase.

l_f = length of end connections in inches (see Fig. 3).

n = number of phases.

p = number of poles.

q = ampere conductors per inch $= \frac{nZI}{\pi D}$

s = slots per phase per pole.

x = reactance of windings per phase in ohms.

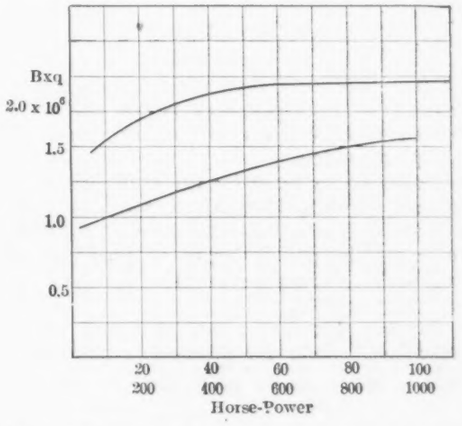


Fig. 2—Product of Ampere Conductors per Inch and Flux Density.

δ = gap length in inches = difference between stator and rotor radii.

Φ = magnetic flux per pole.

Φ_f = leakage lines per amp-conductor per inch of end connections.

Φ_1 = leakage lines per amp-conductor per inch of slot length.

τ = pole-pitch in inches = $\frac{\pi D}{p}$

f = cycles per second.

η = efficiency.

cos Θ = power-factor.

It is usual in direct-current machines and in alternators to plot C, the output factor, on a horse-power basis. This is not satisfactory in the case of induction motors, because

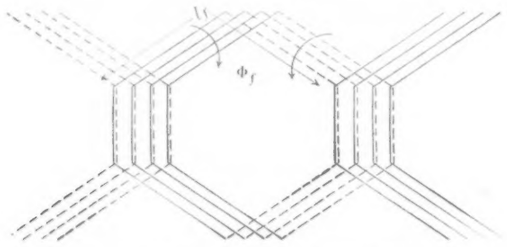


Fig. 3—Winding of One Phase of a Three-Phase Machine.

while $(B \times q)$ and η have definite relations to the horse-power, the power-factor, cos Θ, depends both on the horse-power and the speed, being high for high-speed machines and low for low-speed machines of the same horse-power output.

Fig. 1 shows the values of power-factor and efficiency which may be expected from a line of 60-cycle squirrel-cage motors with open-slot stators. It will be noticed that there are two power-factor curves *a* and *b;* these correspond to the speed curves *a* and *b*. Motors above *a* in speed are high-speed motors, those below *b* are low-speed motors. The power-factor does not increase very rapidly for speeds above those of line *a*, but it drops very rapidly for speeds below *b*. The efficiency is practically independent of the speed.[1]

Hence for induction motors instead of plotting C, the output-factor, against horse-power it will be found more satisfactory to plot $(B \times q)$ to horse-power abscissas. This is done in Fig. 2 for a line of 60-cycle motors.

Then from formula 2:

$$D^2L = \frac{10^{12}}{2.36} \frac{hp}{r.p.m.} \times \frac{1}{(B \times q)} \times \frac{1}{\cos \Theta \times \eta} \qquad (2a)$$

The necessary information for the above equation is taken from Figs. 1 and 2.

The magnetizing current of an induction motor is obtained from

$$I_o = \frac{\Phi \times \delta \times k_2 \times k_3}{\tau L \times 0.91 \times nak_4}$$

where k_2 is a fringing constant used when the slots are open, in which case the air-gap area is not τL, but $\tau L \div k_2$; for open slots on the stator with closed slots on the rotor $k_2 = 1.5$ approximately.

k_3 is a constant to allow for the exciting current necessary to send the flux through the iron part of the magnetic circuit; it is almost constant for all sizes of motors, because, while the gap is larger in machines of large diameter, yet in these same machines the teeth are long, $k_3 = 1.2$ approximately.

$k_4 = 0.96$ for three-phase machines and 0.9 for two-phase machines.[2] Thus for three-phase machines

$$\frac{I_o}{I} = 2.05 \times \frac{B}{q} \times \frac{\delta}{\tau} \qquad (3)$$

The Value of δ, the Air-Gap Length.—There have been a number of formulas proposed for finding the length of air-gap of the form $\delta = m + cD$, where m and c are constants. These were satisfactory when machines of large diameters and short lengths were popular and before much experience had been obtained with very high-speed motors for direct connection to centrifugal pumps, etc. It will be found that the air-gap increases with the diameter, with the length and with the peripheral speed. That is,

$$\delta = f + gD + hL + kV, \qquad (4)$$

where $f = 0.005$, $g = 0.00035$, $h = 0.001$ and $k = 0.003$. These values give the smallest air-gap that will be satisfactory mechanically.

The ideal short-circuit current I_D of an induction motor is determined as follows:

Fig. 3 shows the winding of one phase of a three-phase machine covering a distance of two poles; the winding is a double-layer one.

Φ_f = the leakage flux per amp-conductor per inch of free length of end connections, considering these as a belt.

Φ_e = the total flux threading the coils due to the current in the end connections

$$\Phi_e = \frac{a}{2} \Phi_f \times 2l_f \times I$$

so that the coefficient of self-induction of the end connections = $\left(\frac{a}{2}\right)^2 \Phi_f \times 2l_f$, and the reactance per phase of winding due to the end connections = $2\pi fa^2 \left(\frac{\Theta_f l_f}{2}\right) p$.

Φ_1 = the lines per amp-conductor per inch of embedded length; this includes the stator slot, the rotor slot, and zig-zag leakage.[3]

The flux linking the conductors in one slot = $\Phi_1 bIL$, coefficient of self-induction of conductors in one slot = $b^2\Phi_1 L$, reactance per phase due to the slot part of the winding = $2\pi fb^2\Phi_1 L \times sp$, and total reactance per phase

$$x = 2\pi fa^2p^2n \left(\frac{\Phi_1 L}{snp} + \frac{\Phi_f l_f}{2pn}\right) \qquad (5)$$

Now $\frac{\Phi_1}{snp}$ is approximately constant for a given diameter of machine because if the slots were made double the original width so that Φ_1 would have one-half its original value, yet on the same diameter there would be room for only one-half the initial number of slots.

It is advisable at this point to show the fallacy of the statement which is often made that increasing the number of slots, say, 20 per cent decreases the reactance 20 per cent. For a given voltage and magnetic flux the number of conductors per phase per pole = a is unchanged, so that

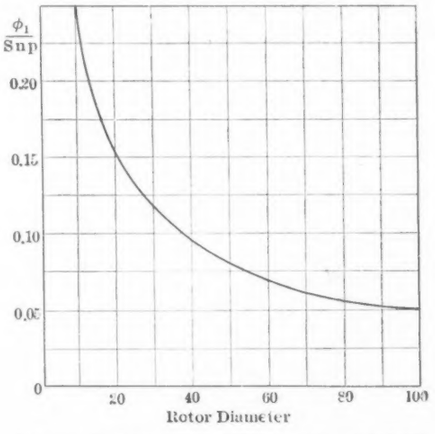


Fig. 4—Variation of $\Phi_1 \div snp$ with Diameter.

if s = the slots per phase per pole be increased 20 per cent
b = the conductors per slot will be decreased 20 per cent,
Φ_1 = the lines per amp-conductor per inch will be increased 20 per cent because the slot is now 20 per cent narrower.
The reactance per slot is proportional to $b^2\Phi_1$, and hence is decreased 20 per cent, but the number of slots per phase

[1] Goldschmidt, *Journal* of the (British) Institution of Electrical Engineers, January, 1908.

[2] McCormick, *Trans.* A. I. E. E., May, 1906.

[3] Adams, *Trans.* A. I. E. E., June, 1905.

per pole is increased 20 per cent; since the windings in these slots are in series the reactance of the whole winding is unchanged. As a matter of fact, Φ_1 contains the zig-zag leakage which is proportional to the width of the

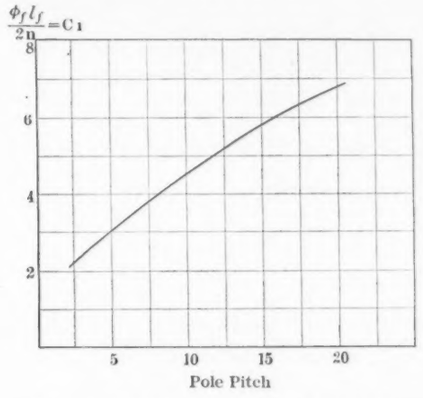


Fig. 5—Variation of C_1 with Pole Pitch.

tooth, and hence decreases as the number of teeth is increased, but for machines with open-slot stators this zig-zag leakage flux is only about one-fourth of Φ_1.

In Fig. 4 $\frac{\Phi_1}{snp}$ is plotted against the diameter and in Fig. 5 $\frac{\Phi_f l_f}{2n}$ is plotted against the pole pitch from the results of tests on three-phase, 60-cycle machines.

With two-phase windings the length of path around the belt of conductors of one phase is approximately 50 per cent greater than for three-phase machines of the same pole pitch, and hence Φ_f is reduced 50 per cent, and the ratio $\frac{\Phi_f}{n}$ is independent of the number of phases—that is, Fig. 5 may be used for both two-phase and three-phase windings.

Now

$$\frac{I_D}{I} = \frac{E}{xI} = \frac{2.22\, k_1 Z \Phi f\, 10^{-8}}{2\pi f a^2 p^2 n L \left(\frac{\Phi_1}{snp} + \frac{C_1}{pL}\right) I}$$

$$= \frac{0.337}{p} \times \frac{B}{q} \times \frac{1}{\left(\frac{\Phi_1}{snp} + \frac{C_1}{pL}\right)} \qquad (6)$$

when $C_1 = \frac{\Phi_f l_f}{2n}$ (see Fig. 5).

by the heating of the machine to about 80,000 lines per square inch for 60-cycle machines and 105,000 lines for 25-cycle machines. The ratio of slot-width to tooth-width in the stator is approximately 1 to 1.1, being slightly greater for machines of small diameter and slightly smaller for machines of large diameter. The average gap density = the

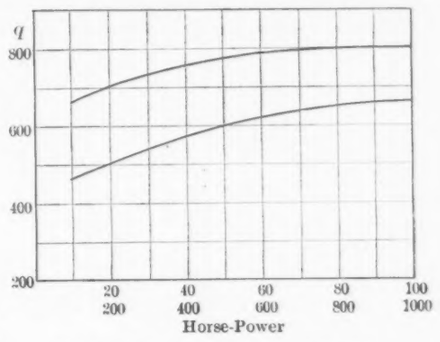


Fig. 6—Ampere Conductors per Inch.

maximum tooth density $\times \frac{2}{\pi} \times \frac{1}{2.1}$, and hence has a value of about 22,000 lines for 60-cycle and 29,000 lines per square inch for 25-cycle machines. Since the magnetizing current is directly proportional to B it is sometimes necessary to use lower values of B than the above in order to keep the magnetizing current low. Twenty-five-cycle motors can have higher gap densities than 60-cycle motors because, for the same diameter and speed, the pole-pitch and therefore the ratio $\frac{\tau}{\delta}$ is larger for 25-cycle than for 60-cycle motors, and so the ratio $\frac{I_o}{I}$ is smaller.

The value of q is limited by heating. Thus in a motor whose coils have an area of M circ. mils and a mean turn of l inches the copper loss in watts is $= \frac{l}{2} \times \frac{ZnI^2}{M}$ since the resistance of copper = 1 ohm per circ. mil-in. Hence $\frac{\text{watts}}{\pi_D \frac{l}{2}}$ = watts per square inch radiating surface

$$= \frac{q}{M \text{ per ampere}}$$

The value of amp-conductors per inch is obtained from Fig. 6. It is plotted against horse-power and not against

Horse-power.	Revolutions per Minute.	f	$B \times q$	$\eta \times \cos\theta$	D^2L	D	L	V	τ	δ	q	B	$\frac{\phi}{snp} + \frac{C_1}{pL}$	$\frac{I_e}{I}$	$\frac{I_d}{I}$
50	1,800	60	1,330,000	0.81	1,100	12	7.6	5.7	9.4	0.034	600	22,200	.215 + .147 = .362	0.275	8.6
50	1,800	60	1,330,000	0.81	1,100	14	5.6	6.6	11.0	0.036	600	22,200	.195 + .221 = .416	0.25	7.5
50	1,800	60	1,330,000	0.81	1,100	16	4.3	7.6	12.6	0.038	600	22,200	.18 + .31 = .49	0.23	6.3
50	900	60	1,330,000	0.79	2,240	16	8.7	3.8	6.3	0.031	600	22,200	.18 + .051 = .231	0.37	6.7
50	900	60	1,330,000	0.79	2,240	18½	6.5	4.4	7.3	0.031	600	22,200	.163 + .075 = .238	0.32	6.5
50	900	60	1,330,000	0.79	2,240	21	5.0	5.0	8.3	0.032	600	22,200	.15 + .104 = .254	0.29	6.1
50	514	60	1,330,000	0.74	4,200	23	7.9	3.1	5.2	0.03	600	22,200	.14 + .027 = .167	0.44	5.3
50	514	60	1,330,000	0.74	4,200	26	6.2	3.5	5.8	0.031	600	22,200	.13 + .038 = .168	0.40	5.3
50	514	60	1,330,000	0.74	4,200	29	5.0	3.9	6.5	0.032	600	22,200	.12 + .051 = .171	0.37	5.2
50	514	60	1,330,000	0.74	4,200	32	4.1	4.2	7.2	0.033	600	22,200	.113 + .066 = .179	0.35	5.0
50	514	60	1,330,000	0.74	4,200	35	3.4	4.7	7.9	0.035	600	22,200	.105 + .085 = .190	0.33	4.7
1,000	900	60	1,950,000	0.86	28,000	32	27.5	7.5	12.6	0.066	800	24,400	.112 + .024 = .136	0.33	9.4
1,000	900	60	1,950,000	0.86	28,000	36	21.7	8.5	14.1	0.065	800	24,400	.102 + .033 = .135	0.29	9.5
1,000	900	60	1,950,000	0.86	28,000	40	17.5	9.4	15.7	0.065	800	24,400	.095 + .042 = .137	0.26	9.3
1,000	240	60	1,950,000	0.80	113,000	100	11.3	6.3	10.5	0.07	800	24,400	.051 + .014 = .065	0.42	5.3
1,000	240	60	1,950,000	0.80	113,000	110	9.3	6.9	11.5	0.073	800	24,400	.049 + .018 = .067	0.40	5.1
1,000	240	60	1,950,000	0.80	113,000	120	7.8	7.5	12.6	0.077	800	24,400	.047 + .023 = .070	0.38	4.9

Discussion of Equations (3) and (6).—The average flux density in the air-gap bears a definite relation to the maximum flux density in the stator tooth. This latter is limited by the heating of the machine to about 80,000 lines per square inch for 60-cycle machines and 105,000 lines for 25-cycle machines. The ratio of slot-width to tooth-width in the stator is approximately 1 to 1.1, being slightly greater for machines of small diameter and slightly smaller for machines of large diameter. The average gap density = the speed because, for a given horse-power, if the speed in r.p.m. is high the machine is small in diameter, but at the same time the peripheral velocity is high and the ventilation

good. If the speed in r.p.m. is low the diameter is large and there is free access to the air; moreover, the slots are deep to allow the use of large conductors.

In many cases a lower value of q than that determined by heating from Fig. 6 may be necessary in order that the short-circuit current and hence the permissible overload may be sufficiently large (see formula 6).

Fig. 7 shows the simple circle diagram for a reasonably

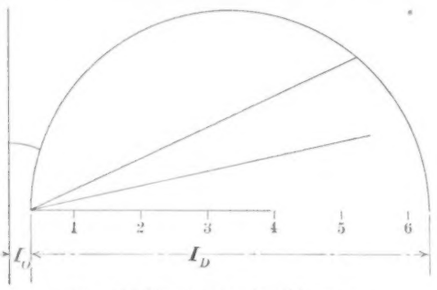


Fig. 7—Simple Circle Diagram.

good induction motor. It has a full-load power-factor of 90 per cent, a starting torque 1.5 times full-load torque, a maximum torque 2.9 times full-load torque and a maximum output 2.3 times full-load rating. To obtain such characteristics as may be seen from the diagram the magnetizing current should not exceed 33 per cent of the full-load current nor should the short-circuit current be less than six times the full-load current.

Examples of Application of the Formulas.—Designs for motors of the following ratings are worked out in the accompanying table:

(a) 4 pole, 50 hp, 60 cycle, 1800 r.p.m.
(b) 8 pole, 50 hp, 60 cycle, 900 r.p.m.
(c) 14 pole, 50 hp, 60 cycle, 514 r.p.m.
(d) 8 pole, 1000 hp, 60 cycle, 900 r.p.m.
(e) 30 pole, 1000 hp, 60 cycle, 240 r.p.m.

The order of calculation is as follows:

(1) Find $B \times q$ from Fig. 2.
(2) Find $\cos \theta \times \pi$ from Fig. 1.
(3) Find D^2L from formula 2 *a*.
(4) Take different trial values of D and L.
(5) Find the peripheral velocity V, and also the pole pitch τ.
(6) Find δ from formula 4.
(7) Find q from Fig. 6.
(8) Find $\frac{\Phi_1}{snp}$ and $\frac{\Phi_f l_f}{2n}$ from Figs. 4 and 5.

Referring to the results which are shown in the accompanying table, it should be noted that the smaller the diameter the lower the peripheral velocity for a given speed in r.p.m., and therefore the greater the heating for a given value of q. It is also important to know that the smaller the diameter of the machine the lower the cost for a given value of D^2L.

Design (a) with a diameter of 12 in. would probably get hot because, owing to the small diameter, it would be difficult to get the air necessary for ventilation in and out of the machine, hence a diameter of about 14 in. would probably be chosen in this case, and as the magnetizing current is only 25 per cent of the full-load current the air-gap would probably be increased to 0.045 in. and still the power-factor would be high.

Design (b) with a 16-in. diameter has too large a magnetizing current for a motor of this speed and thus would not meet the power-factor guarantees demanded by the trade for a motor of this rating. An 18.5-in. diameter machine would be satisfactory and would be cheaper than one 21 in. in diameter.

Design (c) is shown with five different values of D and L in order to disprove the fallacy that the greater the peripheral speed of a motor the better are the characteristics of the machine. As the diameter increases the effective length of the machine decreases, but at the same time the leakage due to the end connections increases. Designs (c) and (e) also show the important fact that low-speed machines cannot be made to have the same characteristics as high-speed machines, but must necessarily have lower power-factors and smaller overload ranges. This is shown in the well-known formula

$\frac{I_o}{I_D} = K\frac{\delta}{\tau}$ developed by Mr. B. A. Behrend,[4] where the value of K can be found from formulas 3 and 6.

[4]Behrend, "The Induction Motor."

OPERATION OF DETECTORS IN WIRELESS-TELEGRAPH SERVICE.

Sensitiveness of Wireless-Telegraph Contact Detectors as a Function of the Contact Pressure.

By L. H. Harris and John L. Hogan, Jr.

THE results of two independent but similar investigations which, when taken together, make it possible to draw a new distinction between two classes of wireless detectors should be of especial interest at the present time. Loose contact or microphonic detectors were the first known in the wireless signaling art, and until the advent of the "current-operated" detector were used exclusively. The merits of this latter type of detectors, which give responses in proportion to the total energy of the received signal, were recognized at once, and at the present time one class of detectors of this type, the so-called "crystal rectifiers," is receiving much attention.

As a representative of the self-restoring microphonic detectors, the one discovered by Hughes,[1] consisting of a loose joint caused by a bright steel needle resting lightly on a pencil of gas carbon, may be taken. This is most effective when used in circuits of the type shown in Fig. 1, where A is the antenna, B and C the primary and secondary of an oscillation transformer, D an earth connection, E a condenser, F the detector, G a head telephone, H a potentiometer and I a cell of battery. From the numerous "good" or firm-contact detectors there may be chosen as examples those consisting respectively of a joint between tellurium and aluminum,[2] between silicon and any

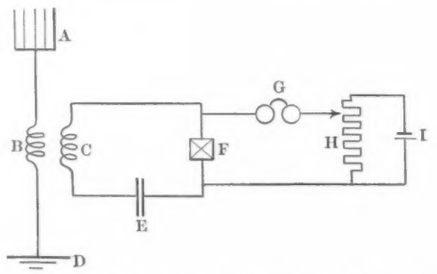


Fig. 1—Arrangement of Circuits with Hughes Detector.

ordinary metal,[3] and between the minerals zincite and chalcopyrite.[4] These detectors operate well in the circuit

[1]See the description of Hughes' 1879-1886 work in the London *Electrician* of May 5, 1899; in the London *Electrical Review* of June 2, 1899, and in Appendix D of J. J. Fahie's "A History of Wireless Telegraphy," Dodd, Mead & Company, third edition, 1902.

[2]L. W. Austin's paper in the *Physical Review*, 1907, page 508, and *Bulletin* of Bureau of Standards, Vol. V, No. 1, April 27, 1908, page 133.

[3]United States Patent No. 836,551, G. W. Pickard; application filed Aug. 30, 1906; patent issued Nov. 20, 1906.

[4]United States Patent No. 912,726, G. W. Pickard; application filed Oct. 15, 1908; patent issued Feb. 16, 1909.

shown in Fig. 1, but are very nearly of the same effectiveness in that of Fig. 2, where no battery is used.

The operation of all these good contact detectors is such that when electromagnetic waves set up alternating currents in the antenna circuit *ABD* and these currents are conveyed to the detector by way of *C* and *E* a unidirectional pulsating or partially rectified current is set up in the circuit containing the detector and the telephone *G* and thus an audible signal is given. The action underlying this operation is not thoroughly understood. In the case of the microphone detectors, it is believed that the

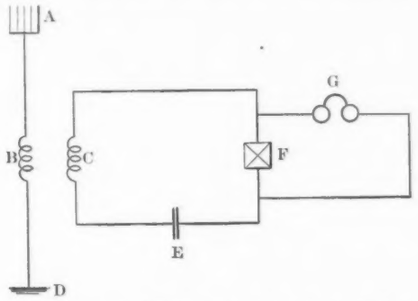


Fig. 2—Arrangement Without Battery in Detector Circuit.

received-wave currents or voltages alter the resistance of the loose joint so that the amount of battery current flowing through the telephone circuit is altered and the signal thereby produced. This explanation obviously cannot apply to the second type of "good" or firm-contact detectors when used without a battery (Fig. 2), and hence a well-demonstrated theory of rectification of the pulses of high-frequency alternating current is generally accepted as explaining the phenomenon even when a local battery is used. Why or how this rectification occurs is still conjectural, though the indications are that the basic action is a peculiar type of thermal regeneration at the contact.

In handling any of these detectors one of the first things that attract notice is that the sensitiveness varies greatly as the point of contact is changed—that is, as different parts of the surfaces of the elements forming the detector are brought into action. It is not so obvious, however, that there is a distinct relation between the sensitiveness of the detector and the force with which the two elements are brought into contact. To show these variations of the sensitiveness of the two types of detectors was the purpose of the investigations here described.

The first tests considered were carried on during 1908 at the graduate physical research laboratories of the Sheffield Scientific School, Yale University, while those on the Hughes device were performed only a few months ago at the University of Pittsburgh.

EXPERIMENTS WITH THE CRYSTAL DETECTORS.

Referring to Fig. 3, a buzzer *J* of constant frequency was arranged in a circuit with a key and battery, and

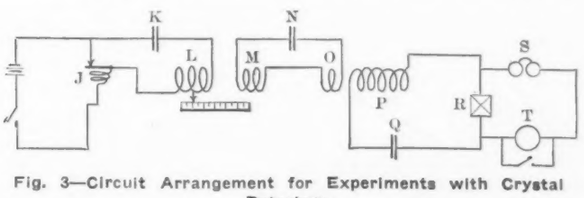


Fig. 3—Circuit Arrangement for Experiments with Crystal Detectors.

across its intermittent contact was placed a condenser *K* of 0.12 mf in series[5] with a small primary L. This primary was arranged in variable inductive relation to a secondary *M*, which with the condenser *N* and primary *O* formed a closed intermediate circuit transferring the high-frequency energy to the detector circuit (secondary *P*, condenser *Q*, and detector *R*). Across the detector were shunted a telephone *S* and a galvanometer *T*, the latter having a short-circuiting switch.

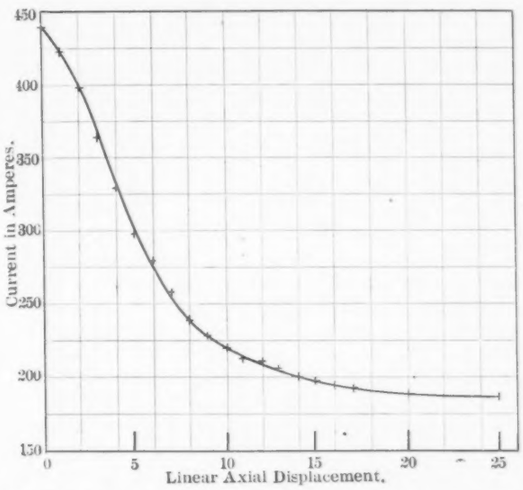


Fig. 4—Variation of Current with Separation of Coils.

The detector holder *R* was made to take interchangeably any pair of the elements under test, and a scale pan was arranged on a balance arm so that the contact pressure of the detector might be varied by changing the weights in the pan.

It will be seen from Fig. 3 that at each opening of the buzzer contact the condenser *K* will be charged, and that it immediately afterward discharges through the primary *L*. This discharge excites the circuit *MNO*, causing it to oscillate at its natural frequency and with an amplitude depending upon the closeness of the coupling between *L* and *M*. The high-frequency oscillations of the circuit *MNO* operate the detector in the associated circuit *PQR* and give a galvanometer deflection or a telephone signal depending in amount upon the coupling between *L* and *M*. Thus, when a scale was placed so as to indicate the distance between the coils *M* and *L* it was possible to determine the change of energy in the circuit *PQR* due to variations in the coupling. The relation between the current in *R* and the axial displacement of the coil *L* is shown by the curve of Fig. 4.

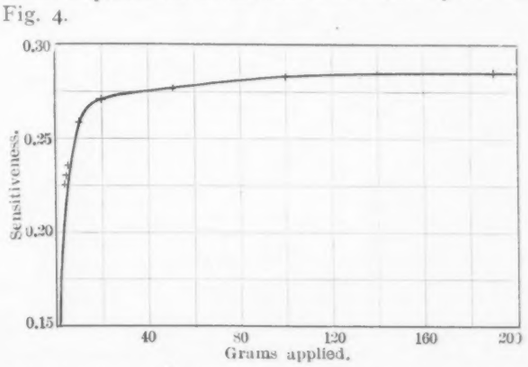


Fig. 5—Variation of Sensitiveness of Silicon-Brass Detector with Pressure.

From the above it appears clearly that if, when a detector is in circuit and adjusted, the displacement between *L* and *M* is increased until the signal in the telephone becomes just audible, the displacement, referred to in Fig. 4, will show (as the square of the corresponding ordinates) a quantity proportional to the energy required to operate

[5]This is a modification of the exciter described by L. W. Austin on pages 149-152 of the *Bulletin* of Bureau of Standards, Vol V, No. 1, April 27, 1908.

the detector. The reciprocal of this may be defined as the sensitiveness of the detector, and so long as there are no great changes in the electrical dimensions of the circuits the single calibration of Fig. 4 may be used with several different detectors with a very fair degree of accuracy.

Method of Test.—A consideration of what has been described developed the following method of procedure. A small weight was placed in the scale pan, and the detector was adjusted to give the loudest possible signal under this pressure. In the course of the adjustment the signal was gradually weakened by reducing the coupling *LM*, and when the final condition of maximum sensitiveness was reached the coils were separated until the signal was just audible, and then the displacement for that pressure was noted.

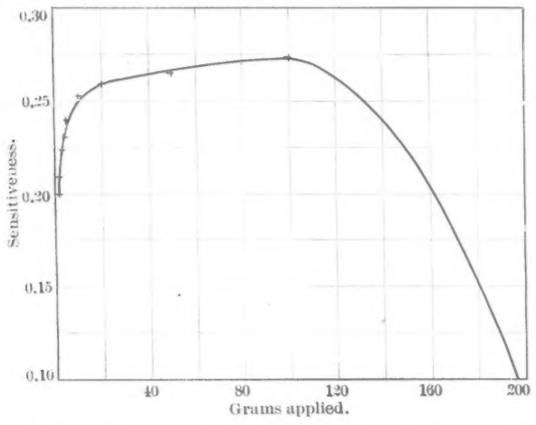


Fig. 6—Relative Sensitiveness of Tellurium-Aluminum Detector.

This process was repeated in the case of each different applied weight for each detector, and the result was checked by further repetition. A special experiment showed the variation in the buzzer's output to be somewhat less than 0.5 per cent when precautions against changes in frequencies were taken. It should be noted that the variation of transformer displacement to the "just audible" point was made without watching the scale of the coupling, so that the possibility of influenced readings was guarded against.

Results.—The transformer displacements were referred to the curve of Fig. 4 for each measurement, the corresponding ordinate was squared, and the reciprocal of this taken. The resulting number, defined here as sensitiveness, is expressed as

$$S = \frac{1}{I^2 K}$$

where I is the current required to operate the detector and K is a constant involving the detector's effective resistance and the galvanometer's sensibility. This number was plotted against the gravity mass acting on the contact, the curves for the three good-contact detectors being shown in Figs. 5, 6 and 7. It is interesting that each shows its maximum sensitiveness at about 100 grams and has low sensitiveness at small pressures.

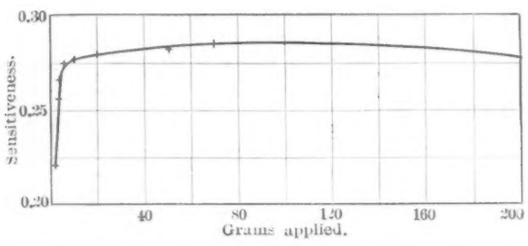


Fig. 7—Relative Sensitiveness of Zincite-Chalcopyrite Detector.

The abscissas are not truly pressures in any common unit, but merely weights that are acting on the contacts. The contact area over which the weight was distributed is practically indeterminate. The value of the results in showing the relation between pressure and sensitiveness is, however, in no way decreased by the necessary use of unknown units.

EXPERIMENTS WITH THE HUGHES DEVICE.

These tests were made with the same purpose in mind as those previously described, but without knowledge that such tests had previously been made. The device as used consisted of a polished steel sewing needle in contact with a pencil of gas carbon. The method employed consisted in supplying energy at a constant rate, in the form of high-frequency alternating currents, to the detector, which was shunted by a local circuit containing a telephone receiver and a battery, as indicated in Fig. 8. An audible signal was produced in the telephone in the manner previously described. The receiver itself was shunted with a resistance, by varying which the current through the receiver, and thus the loudness of the signal, could be changed at will. The sensitiveness of the detector for a given pressure is then indicated by, and is inversely proportional to, the resistance which must be placed in shunt with the receiver to reduce the signals to bare audibility. A sensitive alternating galvanometer in the intermediate tuned circuit indicates the amount of energy being transferred to the detector circuit.

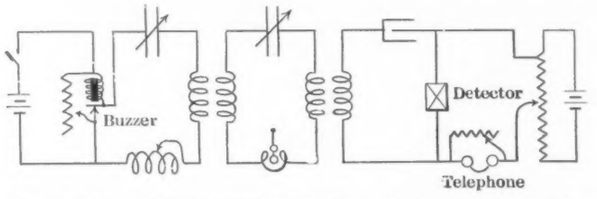


Fig. 8—Circuit Arrangement for Tests with the Hughes Device.

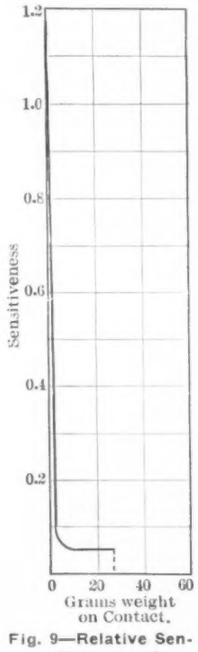


Fig. 9—Relative Sensitiveness of Hughes Device.

One of the elements composing the detector was fixed while the other was carried on the end of a balanced beam, which also carried a weight pan. Small masses in the form of ordinary milligram weights were added to the pan, thus varying the magnitude of the contact pressure. The results of these tests were plotted in the form of curves, a typical curve being shown in Fig. 9.

In every instance the Hughes device showed a maximum sensitiveness at a minimum pressure, the sensitiveness falling rapidly to a moderate value with slight increase in pressure and at a comparatively light pressure failing altogether. This would seem to bear out the opinion expressed in the first part of this article as to the nature of the action of this type of detector. In the case of the "good" or firm-contact detectors the sensitiveness is a minimum at the minimum pressure, rises rapidly and remains nearly constant over a wide range of pressure.

That there is a fundamental difference in the method of operation of these two types of detectors will become evident if a comparison be made of the forms of the resulting curves, Figs. 5, 6, 7 and 9.

ELECTRICAL RESISTANCE OF SOLID-METAL SOLUTIONS.

DIFFUSION between solid bodies, especially metals, has been shown to take place under suitable conditions, this striking phenomenon being ascertained by chemical analysis or micrographical observation. In a paper recently read before the Accademia dei Lincei Messrs. G. Bruni and D. Meneghini suggest another method, based on the physical properties of the solution formed, and especially on variations of the electrical resistance of the two metals in contact with one another.

It is a well-known fact that the specific resistance of an alloy generally is considerably greater than that of any one of the component metals. A constantan wire (40 per cent nickel, 60 per cent copper) thus possesses a resistance forty-seven times as high as that of a copper wire and six times as high as that of a nickel wire of equal length and cross-section. These remarkable variations in resistance thus allow the diffusion between two metals to be watched in all its phases.

Repeated resistance readings show two solid metals in contact with one another to give rise under suitable conditions to a phenomenon of diffusion, both of them assuming in the end all the properties of an alloy, inclusive of an increase in specific resistance.

The author coated a nickel wire 0.5 mm in thickness by electrolysis in a bath of potassium copper cyanide at very low current intensity (0.1 amp) with a very compact copper layer, the thickness of which was so chosen that the two metals are present at the same ratio as in constantan.

Time After Heating, Hours.	Resistance, Ohm.
2	0.0256
6	0.0279
10	0.0290
18	0.0723
34	0.1372
48	0.1641
70	0.1883
90	0.1980
115	0.2065
135	0.2097
157	0.2105

The wire was inserted for about 20 cm length into a thin porcelain tube located in a Heräus resistance furnace capable of maintaining the temperature at 1000 deg. C. with very little fluctuation. The wire is thus maintained at 80 deg. below the melting temperature of the most fusible metal. Any trace of melting would, by the way, have been immediately detected, this metal being situated outside. A current of dry hydrogen which was forced through the porcelain tube prevented the occurrence of any oxidation.

Before heating the wire had a resistance of 0.0260 ohm. After being heated for various lengths of time the electrical resistance was ascertained at given intervals, the result of a number of tests being as summarized in the table.

At this point the electrical resistance shows the copper-nickel to have been converted entirely into constantan. In fact, the curve expressing the increase in resistance in terms of time here becomes nearly parallel to the X-axis. Chemical analysis shows the wire to contain for each 0.2909 gram of alloy, 0.716 gram, or 58.9 per cent, of copper, which percentage agrees with that of constantan, having the same specific resistance. The slight decrease in resistance which will be observed at the beginning of the table is attributable to the action of heating on the surface layer.

ELECTRIC PUMPING FOR IRRIGATION.

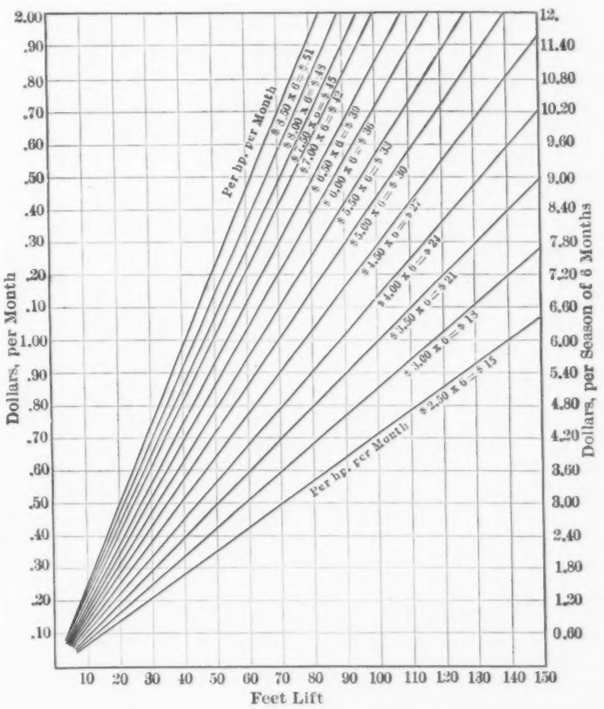
By H. E. M. KENSIT.

WITHIN the area of most irrigation undertakings there is a considerable proportion of land above the reach of the ditches. Some of this may be in blocks of land for which therefore water rights cannot be sold. Much of it is made up of parts of the holding of each individual farmer, such part being consequently out of cultivation. Usually some allowance is made in the water-right charges for this elevated land. Both parties to the contract are therefore anxious to irrigate this higher land, the farmer in order to get the whole of his holding under cultivation, and the irrigation company in order to increase its revenue from water rights, and every facility is usually given to the individual farmer or group of farmers to pump water from the gravity ditches to their higher lands.

In most districts where there is irrigation on an extensive scale electric power is developed either at the irrigation dams or at nearby points by separate companies, and as this pumping occurs only at times which do not overlap with the winter load of the power stations, energy can usually be obtained at low rates.

The lifts required vary from 2 ft. or 3 ft. to 100 ft. and sometimes more; the price of energy varies in every district with the amount required and the distance to which it has to be transmitted; also the actual cost of delivering the water on the land depends directly on the height of lift as affecting the amount of energy taken, and the total cost is affected by the length of season during which irrigation is required.

The diagram given herewith takes all these factors into consideration and enables any man unfamiliar with the



Cost of Irrigation per Acre at 50 Per Cent Efficiency.

technical side of the question to determine whether a given area of land at a known height above the water supply can be profitably irrigated at a given charge per hp-month or season of six months.

If the charge per hp-month includes, as is often the case, the installation and rent of the pumping sets, then the

diagram gives all the information necessary to come to a decision, except as to cost of shed and piping from the low level to the nearest point on the high-level ditch. If the land owner has to supply the pumping equipment allowance must be made for interest and depreciation on the cost. If well-chosen electrically driven centrifugal pumping sets are installed the cost of repairs should be very small, and the cost of attendance for such an application as is under consideration would be quite negligible.

The diagram shows the cost per acre for any given lift at any charge per hp-month, assuming 50 per cent over-all efficiency for electric motor and centrifugal pump and one-eighth of a cubic foot of water per acre per second, and is figured thus:

$$\frac{1}{80} \times \frac{62.35 \times 1}{550} \times \frac{100}{50} = 0.00283 \text{ hp per foot of lift.}$$

Having determined the charge per acre that the land will stand, a reference to the diagram will show at what price the power must be supplied for any given lift to keep within this charge. Thus $2.40 per acre per season would pay for a 47.5-ft. lift with energy at $3 per hp per month, but would pay for only a 41-ft. lift if energy cost $3.50 per hp per month.

Careful consideration must be given to the efficiency of the pumping set as affecting the cost of watering the land. A 5-hp pumping set may have an over-all efficiency of only 40 per cent, while a 400-hp to 500-hp set may have an over-all efficiency of 70 per cent. The cost per acre shown on the table must therefore be corrected proportionately for other efficiencies than 50 per cent, the efficiency depending on make and size of pump and motor and on the height of lift.

Central Station
Management, Policies and Commercial Methods

INDUSTRIAL ELECTRIC SIGN FOR LEOMINSTER, MASS.

A large electric sign 100 ft. long and 10 ft. high will shortly be erected at Leominster, Mass., by the Leominster Electric Light & Power Company, for the purpose of calling attention to the advantages of the town as a manufacturing center. The sign will be located within easy reading distance of the principal trunk-line railroad reaching the community.

CENTRAL STATION RECONSTRUCTED IN TWENTY-SIX DAYS.

The Campbellsville (Ky.) Lighting Company believes that it established a record recently in putting its plant in operation just twenty-six days after a fire had practically destroyed it. The plant was burned Nov. 15 by a fire of unknown origin, the building being entirely consumed and the main dynamo apparently put out of commission permanently. The morning after the blaze a big force was put to work and within twelve hours foundations for the new structure were being laid. The new building was completed within six days, night and day shifts of builders being employed in order to rush the construction job through. The dynamo had meanwhile been shipped to Louisville for repair and additional parts of the new equipment ordered. Delivery took longer than had been expected, but the work was finally completed Dec. 11, and lights were turned on amid the whistling of every manufacturing plant in the town. The local papers, of course, declared that the power house had arisen "phœnix-like from its ashes."

CENTRAL-STATION COMPANY'S SIMPLE LABORATORY FOR TESTING APPLIANCES.

W. S. Barstow & Company, New York, engineers, and managers of the Associated Gas & Electric Company, which operates a number of gas and electric companies in New York State, have installed a simple laboratory in their New York office for testing the relative merits and economy of various makes of gas and electric appliances before putting them in the different showrooms. The equipment for testing the gas appliances is merely a test meter and taps to the gas lines in their office building, and the equipment for testing the electric appliances consists of an ammeter, a voltmeter, the lighting circuit in the office building, and a rheostat to regulate the voltage of the latter to correspond with voltages of the various electric plants. The energy consumed by different makes of toasters, irons, etc., is easily determined, and before instituting an appliance campaign the company is able to ascertain whether the cost of energy for operating a particular appliance is going to be excessive and its introduction unwise.

TECHNICAL JOURNAL CLIPPINGS IN NEW BUSINESS WORK.

By H. W. Brunell.

The writer has found that in many instances articles appearing in technical journals have proved very beneficial in securing new business for central stations, and especially power business. In soliciting the latter class of business power solicitors encounter prospective customers who are desirous of making some kind of change, but, owing to a limited knowledge of electricity, are somewhat skeptical about taking up the electric drive. Those who have solicited for any length of time have doubtless found persons with whom, it was felt, contracts could be closed if they could only bring out some convincing argument to eliminate the doubt as to the feasibility of the electric drive in the particular class of business under discussion. I do not know of a better or more forcible argument in such cases than to present data, photographs and descriptions of installations along the same lines as that of the prospective customer.

Articles appearing in the electrical journals and other publications giving detailed information and data of various motor installations prove very valuable in inducing the adoption of the electric drive. The pages in journals can be removed, clipped together and then filed, according to their class, ready for reference or to submit to those interested. Where it is a question of doubt regarding the electric drive, if the prospective customer sees or reads of other manufacturers using electricity, it goes without saying that it has a great effect in influencing him. A good way to get power business is to submit the customary specifications and then supply the manufacturer with the names of all local manufacturers in his line who use electric power. If there are no local concerns, then one can draw on his clippings to show that others have installed motors

and found them satisfactory. An article clipped from one of the many publications and mailed to the prospective customer's home which describes an installation similar to the one which it is proposed to install will be read and receive consideration when another communication might find a place in the waste-paper basket.

MOTORCYCLES IN REPAIR DEPARTMENT.

The Louisville Lighting Company has purchased two motorcycles for use in its repair department. They will be used in special cases of emergency where it would require too much time to get fully equipped wagons to the desired location. Each of the two machines is specially equipped with a carrier for repair kits and auxiliary parts. Motorcycles are well adapted for the hurry-up work of the big electric company because of their utility in sections where poor highways make progress for larger vehicles next to impossible, as well as on account of their low upkeep expense.

ORNAMENTAL STREET-LIGHTING SYSTEM IN WILMINGTON, DEL.

In the presence of an immense throng of people assembled in front of the City Hall, Dec. 18, Mayor H. W. Howell closed the switch which illuminated Market Street, Wilmington, from Front Street to Tenth Street, and marked the beginning of a new era of progressiveness in the chief city of Delaware. The celebration accompanying the inauguration of the new lighting system was most enthusiastic. Every business house and public building along Market Street was illuminated and decorated for the occasion, and a monster automobile parade of more than 200 cars added materially in celebrating the occasion. The tungsten-lamp posts replaced the old arc lamps, and in that section of the street illuminated 172 80-cp lamps were required. It is the purpose of the Street and Sewer Department to burn half of the lamps all night and the other half until midnight or 1 a. m. The rate per lamp per annum of 4000 hours is $21.48, and the rate per lamp burning until 1 a. m. is $16.32 a year.

CENTRAL-STATION SOCIAL AFFAIR.

On Dec. 21 the Louisville Lighting Company and the Louisville Gas Company, which are operated jointly, gave an informal dance and reception in their building to enable their employees to meet Gen. George H. Harries, who assumed the presidency of the companies recently. Handsomely engraved invitations were sent out to office employees, salesmen and others, including friends of the company.

The third floor of the handsome building on Chestnut Street, near Fourth Avenue, was devoted to the occasion, and it was beautifully decorated with incandescent lamps, flags, flowers, etc. A complete ball orchestra was provided, and President Harries and the officers and directors of the company formed the receiving line. The affair began at 8:30 o'clock and terminated about midnight.

Dancing was arranged following the reception, and a program of vaudeville specialties filled up an intermission. These included a Highland fling danced to the music of a bagpipe, songs and selections on the harp by noted entertainers. Euchre and whist games were provided for those who did not care to "trip the light fantastic." The feature of the evening was a short talk made by President Harries to the employees of the companies.

"A public-service corporation," he said, "is in one respect no stronger than the personal bearing of its employees. A discourteous action or hasty speech on the part of anyone connected with the company, no matter how unimportant he may seem to be, invariably reflects discredit upon the entire institution in its work of serving the people.

"You are all members of a big system, each one being a very important unit. Wherever trouble meets you you simply have to smile broadly and do your level best to accomplish the seemingly impossible in righting that trouble. You can't please everybody, but you can do the best you know how, and in this way you will be doing your share toward the big things which Louisville has in mind."

Gen. Harries' emphasis upon the importance of the employee maintaining right relations with the public may explain why the company went to such pains and expense in preparing the event just recorded; for it is certain that the interest and loyalty of those connected with the lighting company has been measurably stimulated.

COMMONWEALTH EDISON COMPANY ORDERING TWENTY-FIVE ELECTRIC VEHICLES.

Practising what it preaches in relation to the use of electric vehicles, the Commonwealth Edison Company has sent out specifications asking electric-vehicle manufacturers to submit bids for twenty-five commercial electric vehicles to be used by the company in addition to the large number already in service. Proposals for these vehicles will be received until Jan. 4 by the purchasing department of the company at 120 West Adams Street, Chicago. The twenty-five vehicles required are divided into these six classes:

No. 1—Eight vehicles for the stores department, each to have a carrying capacity of 4000 lb., 95-in. wheel-base and canopy cover.

No. 2—Two vehicles for the stores department, each to have a carrying capacity of 1000 lb., 76-in. wheel-base and panel cover.

No. 3—One vehicle for the street department, to have carrying capacity of 4000 lb., 95-in. wheel-base and frame cover.

No. 4—Eight vehicles for the street department, each of 4000 lb. carrying capacity, 106-in. wheel-base and frame cover.

No. 5—Five vehicles for the customers' repairs department, each of 4000 lb. carrying capacity, 106-in. wheel-base and frame cover.

No. 5—Five vehicles for the customers' repairs department, each of 1000 lb. carrying capacity, 76-in. wheel-base and panel cover.

No. 6—One vehicle for the sign department of 1000 lb. carrying capacity, 95-in. wheel-base and frame cover.

All vehicles must develop a mileage of 40 miles with lead battery or 50 miles with Edison battery on one battery charge. The speed requirement is from 12 to 14 miles per hour on level, smooth pavement when carrying half the rated load. Lots 2, 5 and 6 of those enumerated above may be equipped with any number of lead cells, from forty to forty-four. In case an Edison battery is used sixty cells shall be furnished with each vehicle. Bids on both lead and Edison batteries must be furnished in each class. Each vehicle must be provided with one headlight, one tail-light, one odometer, one Sangamo ampere-hour meter, one foot-operated gong, one charging plug with connecting lead, hood and curtains for protection of driver and the necessary repair tools. Additional information may be obtained from the chief operating engineer of the company. The bodies of the vehicles have been specially designed for the requirements of the various departments, and blueprints accompany the specifications, although considerable latitude is allowed as to the chassis.

CONTRACTOR'S MOTOR-OPERATED SAND AND GRAVEL HOISTING PLANT.

The E. T. Slider Company, of Louisville, Ky., dealer in coal, sand and gravel, has erected a motor-driven hoist runway for unloading its materials from river barges and depositing them in separate piles in its yards, 20 ft. above the mean level of the river. The structure consists of an

Fig. 1—Hoist Housing, Incline and Runway.

elevated runway, 500 ft. long and 30 ft. above the ground, extending the length of the yard and approached by an incline with a grade of 40 per cent from the water's edge. Up this incline the automatic side-dump cars, running on industrial-gage tracks, are hoisted by a 112-hp Westinghouse slip-ring motor, which drives two 6-ft. cable drums.

After reaching the top of the runway the loaded car is run out onto the level trestle work to the point where it is to be dumped. There, with the aid of a track tipple, its swinging sides are released and the material is discharged into the piles at the base of the trestle. In this way sands and gravels of different fineness can be delivered to their appropriate piles or bunkers.

On its return trip the car is propelled by a 1000-lb. weight acting through a Chinese-windlass cable gearing with a reduction of 16 to 1. The weight is raised during the car's passage, while loaded, from the top of the incline to its dumping position, and is then ready to return the car over the level track to the head of the incline. Beyond this point, of course, the car can be lowered by its own weight to the water's edge. The counterweight mechanism is ingeniously arranged with a clutch and cable which engages the car during its travel on the horizontal portion, releasing again

Fig. 2—Interior of Motor Operator's Station.

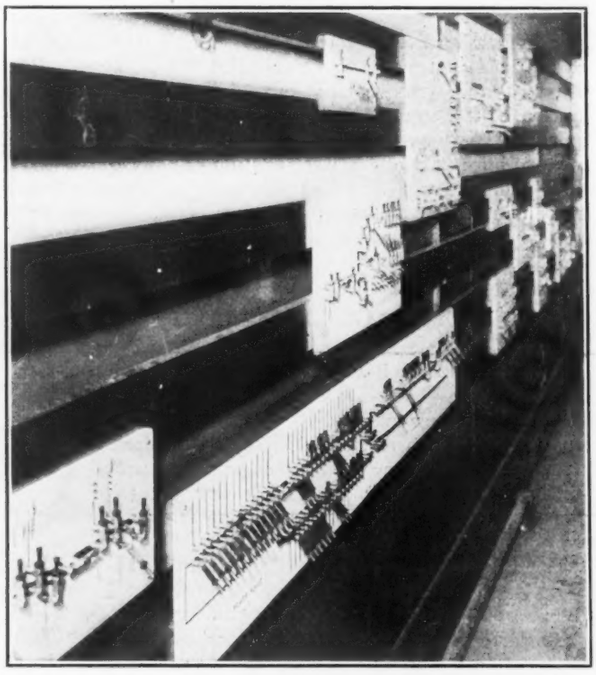
when the car starts down the incline. As the result of this unique arrangement of cables and counterweight, a more nearly uniform load is imposed on the motor, which during the hoisting operation is required only to raise the car, while later, during the period of lower demand required by the loaded horizontal travel, potential energy is also stored up for the return trip. Each of the cars in use weighs 2 tons empty and will hold about 5 tons of sand or gravel, making a total load of 7 tons to be hoisted up the 50 per cent incline. The motor is operated from the lines of the Louisville Lighting Company, and the installation is expected to save a large amount over the former methods of hauling the sand up the levee with mule teams.

Another interesting application of motor power in Louisville is the operation of the concrete mixer used for construction purposes by the Louisville Railway Company. Until recently the concrete used by this company, which does all its own construction work, was prepared by hand, an immense amount of labor of course being required. Recently the company purchased a mixing machine, which was installed on a construction car. Instead of utilizing the usual steam-engine power plant, the company installed a motor, connecting it with overhead trolley wires, and has since used this outfit with excellent success.

LOAD DISPATCHER'S RECORD BOARD.

The office of the load dispatcher of the Detroit Edison Company has just been equipped with a complete record board on which every oil switch and the principal disconnecting switches and jumpers of the system are represented by miniature knife switches, as shown in the accompanying illustration. The position of all oil switches is shown by small-handled knife switches, while the disconnects are similar tiny blades with hook eyes.

The new record board is mounted on a background of white enamel, the buses being represented by metal strips and the circuits by colored lines corresponding to the voltages. The 22,000-volt system is reproduced in red, the 4600-volt circuits in black, and the 2300-volt lines in green.



Circuits of Delray Stations and Nearby Substations in Miniature.

This nomenclature is similarly carried out to the machines, transformer windings, etc., which are diagrammed by the usual symbols, so that the condition of the system is evident at a glance. All oil switches are manipulated under orders from the operating department in the downtown offices of the company, which also receives reports of the operation of any plant switches.

Each panel of the board represents a generating station

or substation. At the lower left-hand corner is seen the long panel reproducing the principal Delray plant of the company. The No. 1 power house is shown at the right and the No. 2 station at the left, the two station buses being linked by a tie switch. The illustration also shows the loop bus construction used at Delray. Part of the generators are arranged for connection to each side of the bus, so that much of the flexibility of a double bus is obtained, although its duplication is avoided. Nearly 200 miniature knife switches are used to reproduce the Detroit system, a single-pole dummy switch representing each three-pole oil switch or trio of disconnector transfer switches.

Wiring and Illumination

AWNINGS THAT OBSCURE "WHITE WAY" MUST COME DOWN.

The city of Fort Worth, Tex., recently installed a handsome "white way" of tungsten standards, the energy for operating which is furnished by the Fort Worth Power & Light Company. A number of awnings extending out from adjoining buildings obstruct the view of this special lighting in places, so that the City Commission has ordered their removal. Some question has been raised as to the power of the commission to remove the awnings, but it is declared that the shades prevent the light from reaching the sidewalks, and the commission, after granting a two-week respite on account of Christmas shoppers, has ordered every awning down by Jan. 1.

SPECIAL CABLE POTHEADS USED IN CLEVELAND.

Where the 2300-volt and 6600-volt lines of the Cleveland Electric Illuminating Company are transferred from open-wire to cable construction, use is made of the special bell-covered potheads shown herewith, which were developed by the company's engineers to meet local conditions. The inner block of the pothead carries three double connecting lugs separated from each other by the porcelain body and vertical barriers and shielded from the weather by the inclosing bell which is dropped over the pothead. The cable

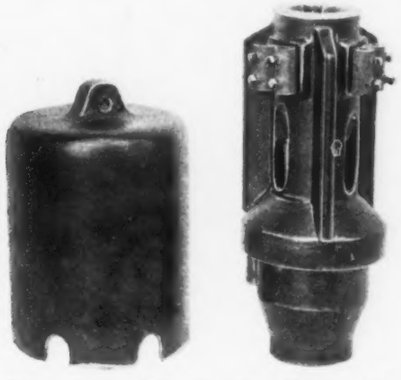


Fig. 1—Protecting Cap and Pothead Body.

end is prepared by removing the covering to a point within the pothead bushing, the exposed end being taped with varnished cambric tape. The separate cable conductors are led out through the slots at the middle of the body and made fast in the lugs, which will take wire sizes up to No. 0. The lugs are held in place by bolts through the body wall, the chamber at the top, for access to the bolts, being filled with insulating compound. When very large conductors are to be used the lugs are left free to be slipped over the wires and then bolted, the insulating compound being poured with the wires in place. The leads to the overhead lines are looped downward from the lugs and pass beneath the bell, which is dropped over the pothead body. For inserting small wires in the lugs sleeves are first soldered on their

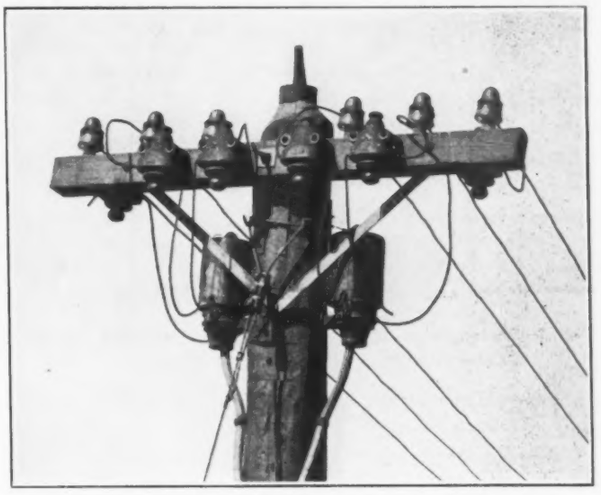


Fig. 2—Potheads on Customers' Cable Service Line.

ends and then tightened under the bolts. The nitches in the bell are so spaced as to hold the wires away from the pole.

About 1000 of these potheads are in use in Cleveland and appear thoroughly successful in service, in addition to the simplicity of preparing and installing them. A number may be noticed in use along Euclid Avenue, Cleveland's famous residence street, where the cable-house services are tapped off from the overhead street lines. Some of these potheads have even been accidentally left in service without the protection against the weather afforded by their shelter caps, but this has resulted in little trouble before being discovered. Another pothead was tested for a year on 13,200 volts near the smoke from a salt-refining plant, which might be expected to give the part pretty severe service. The pothead was designed by Mr. H. L. Wallace, electrical engineer, and Mr. E. E. Noble, superintendent of construction, of the Cleveland company.

THE EFFECT OF FROSTED LAMP TIPS ON LIGHT DISTRIBUTION.

By Albert Scheible.

Lamps with either part or all of the bulb frosted have been used ever since incandescent lamps came into general service, being usually chosen either for the increased decorative effect of the frosted bulb or because the glare of the light is reduced by the frosting. Lately lamps in which only the hemispherical tip is frosted have been growing in popularity for use with prismatic glass shades and even more so with the bowl-shaped opalescent shades which have been offered in increasing variety during the last few years.

From an artistic standpoint, the softening of the glare by thus veiling that part of the lamp through which the filament would otherwise be directly visible is certainly a great improvement. However, the suppression of glare and the improved artistic effect are not the only reasons for the use of the so-called "bowl-frosted" lamps, as this frosting affects the distribution of the light to an extent not generally appreciated even by some of those interested in planning effective illumination.

Thus, in the case of hemispherical bowls, some of the rays of light striking the frosted portion are reflected upward against the bowl and, when redirected by the latter, add to the light immediately under the lamp. In some instances the difference is surprising, as, for example, in the case of the bowl reflector from which the accompanying

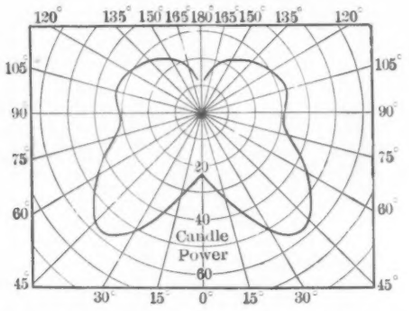


Fig. 1—Photometric Curve of a 60-Watt Clear-Bulb Tungsten Lamp in a Bowl Reflector.

photometric curves were made. With a clear-bulb 60-watt tungsten lamp this gave about 24 cp vertically under the lamp and a maximum of about 57 cp at an angle of about 42 deg. from the vertical (Fig. 1). On substituting a bowl-frosted lamp of the same wattage and size of bulb the vertical candle-power was increased to 36 and the

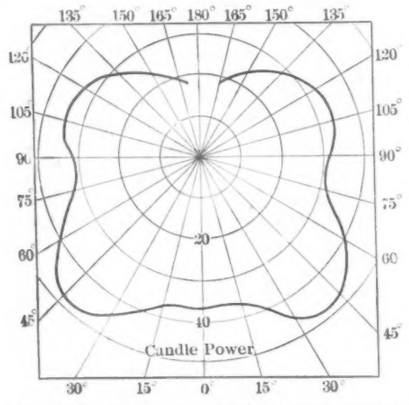


Fig. 2—Photometric Curve of a 60-Watt Bowl-Frosted Tungsten Lamp in the Same Reflector as Used for Fig. 1.

maximum to about 48, the latter being still at about the same angle from the vertical (Fig. 2).

Fig. 3 shows the resulting light distribution, the dotted curve plotting the calculated foot-candles on a plane 5 ft. below the clear-bulb lamp. This dotted line clearly shows a drop in the illumination immediately under the lamp, which drop cannot readily be leveled by any overlapping

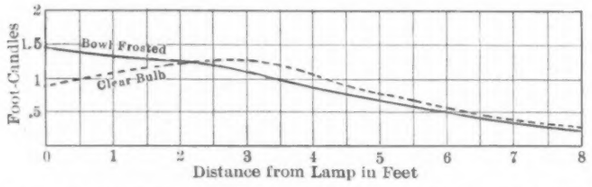


Fig. 3—Calculated Distribution with Clear and Bowl-Frosted Bulb Lamps.

of light from other units or by diffusion from walls and ceilings. On the other hand, the same bowl reflector with a bowl-frosted lamp gave almost a straight-line effect (as shown by the solid line) which would lend itself readily to a leveling of the light distribution by the joint action of a number of such units when suitably spaced and by the diffusion of light from walls and ceilings.

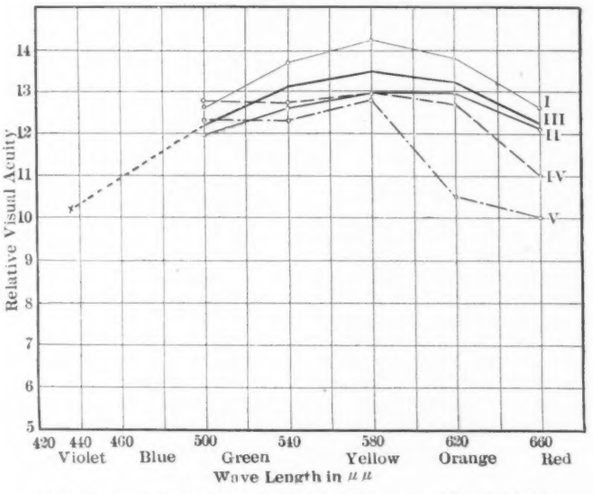
Three conclusions will be evident: First, that the frosting of lamp tips offers an easy means of improving certain classes of light distribution curves; second, that with every photometric curve of an incandescent-lamp unit it should be stated whether the lamp bulb was clear or frosted; and, third, that where the light distribution was carefully planned for bowl-frosted lamps the user should understand this and should be urged not to substitute lamps with clear bulbs. Unless this point is emphasized, some will always be found ready to insert clear-bulb lamps when the original frosted ones have burned out.

Letter to the Editor.

Visual Acuity.

To the Editor of Electrical World:

Sir:—As I have allowed myself to become interested in that branch of electromagnetic waves called light or optics, I was naturally interested in reading the articles and letters that have recently appeared in your columns on the subject of visual acuity. I must confess that I do not exactly understand what Mr. Luckiesh means by the term, which does not seem to imply merely acuteness of vision. His article in your issue of Nov. 18 refers especially to the effects of color or wave-length. I think we are all familiar with the diagram of the spectrum indicating intensity as measured by the heat effect, chemical effect and by the visual effect, which I suppose very plainly shows the variation of the ability of the eye to perceive the different colors or wave-lengths. Fig. 2 in that article, reproduced herewith, seems to agree with the old diagram. The limit of vision, if of a single object, is not given by its size, as we all know, for if bright enough it will be seen, as the stars are seen, no matter how small. That is the principle involved in ultra-microscopy. But if we take a series of equidistant ruled lines, then the limit is between 100 and 400 lines to the inch at a distance of 10 in., the standard distance for reference. Now, we come to the part that will, I suppose, be the most interesting and surprising to those who have not looked far enough into the matter to learn



Variation of Visual Acuity with Wave-Length of Light.

that the factors that govern are not the acuteness of the eye, but the same ones that govern in the great majority of optical instruments, notably the camera, the telescope and the microscope. To put it in another way, the eye is so perfect that the limit of vision is fully reached by its powers or fineness of structure. The limit is given by optical considerations or the laws of light.

It was the common idea that with sufficient magnification anything could be seen, but we now know that it is not so. We now think of the light as being (electromagnetic) waves, and know that, as waves may be added together to give increased effect or to obliterate each other, the limit is given by those arrangements that cause the obliteration of fine details. This is the aperture or diaphragm of the camera, the telescope, the microscope and the eye It is also a function of the wave-length, which, of course, we have to call color. Mr. Ives has exhibited the increased resolving power of the microscope given by light of the blue end of the spectrum over the red or yellow. It may be of interest to state these limits in a few cases. In the telescope the limit of useful magnification is about nine times the aperture in inches, and in the microscope the number of lines to the inch that may be seen is about 80,000 times the aperture expressed in a function of the circle, which will figure out a little over 100,000 lines to the inch.

As the average wave-length is about one-fifty-thousandth of an inch, we can see two lines in the length of a wave of light. As the blue light has a wave-length of a little more than one-half the red, it enables us to see more lines to the inch, but not quite twice as many. For the telescope the formula is given by Lord Rayleigh in the article on "Wave Theory" in the Encyclopædia Britannica (tenth edition). Helmholtz probably first showed the application of the principle to the microscope, but Abbe, who was the head of the best known firm of German opticians, has the credit of working the matter out very elaborately. A piece of microscopic apparatus that bears his name does not pretend to be achromatic.

Helmholtz did speak of the eye as not being perfect, but our celebrated American scholar Robert W. Wood thinks Helmholtz was too critical and refers to the wonderful fact that it is an optical instrument with a perfect automatic diaphragm or iris. I would call attention to another automatic adjustment that tends very largely to correct any slight imperfection it may have, namely, that the eye always centers itself on whatever is looked at and the errors are negligible at the center.

The camera lens has seven distinct aberrations or errors which have to be corrected to make it perfect, without counting those due to the color, and there are half as many again under that head. The seven cannot be all corrected perfectly at once, and a compromise is made in some way to meet given conditions. The eye is known not to be perfectly achromatic, but it is so nearly so that its defects are seldom or never noticed in ordinary life. I have noticed that a bright-colored window such as is common in the churches sometimes gives an effect whereby the parts of different color appear to be in different planes.

Somehow I cannot get rid of the thought that it is rather odd to criticise the eye, to which we must look as the judge in these matters. Still, if these gentlemen can in any way improve our powers of vision no one would welcome it more than I.

Brooklyn, N. Y. J. P. WINTRINGHAM.

Digest of Current Electrical Literature

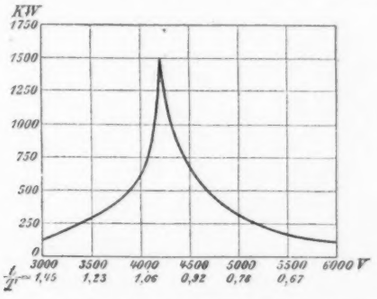
ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Parallel Operation of Alternators.—L. SCHÜLER.—In the parallel operation of alternators oscillations may be produced by resonance between the natural oscillations of the dynamo and the periodic impulses of the prime mover. For the period t of the natural oscillations of a dynamo Rosenberg has given the formula

$$t = c\sqrt{\frac{GD^2\, n}{p\, C\ \text{kva}}}$$

where GD^2 is the moment of inertia in kilogram-meter units, n is the number of revolutions per minute, p the number of pairs of poles, C the ratio of the short-circuit current (for the exciting current required to give normal voltage at no load) to the normal current, kva the normal kilovolt-amperes, and c a coefficient for which Rosenberg found the theoretical value of 0.032. The author has tested this formula by experiments carried out as follows: Two identical machines are operated in parallel and gradually their excitations are changed until oscillations occur. A resonance curve is then plotted with the amplitudes of the oscillations of the wattmeter as ordinates and the voltages as abscissas. The cut shows such a resonance curve for two three-phase generators driven by double-acting tandem gas engines, where the resonance maximum occurred at 4200 volts (the period t of the natural oscillations of the generators being then equal to the period T of the disturbing impulses of the gas engines). From this experiment the author finds that c in the above formula has the value 0.0264. By similar experiments with former different machines, values of c were found which varied between 0.0254 and 0.0273 instead of Rosenberg's theoretical value 0.032. For the predetermination of the oscillation period t the value of the ratio C of the short-circuit current to the normal current is unknown. But, since the short-circuit current depends on the ratio of armature ampere-turns to field ampere-turns multiplied by the stray coefficient, and since the stray coefficient may be taken as 0.8 on the average, the above formula may be changed into



Resonance Curve for Two Three-Phase Generators.

$$t = 0.03\sqrt{\frac{GD^2\, n\, R}{p\ \text{kva}}}$$

where R is the ratio of armature ampere-turns to field ampere-turns and t is the period of the oscillations at no load. The value of t for inductive full load is about 15 per cent smaller. The author then gives two interesting tables for the values of t and T which occur in practice with the usual types of machines. When $t = T$ there is resonance. No trouble may be expected if $t \div T$ differs from unity by at least 20 per cent. If two electric machines operating in parallel have the same natural periods of oscillations, t_1 and t_2, so that $t_1 = t_2$, then the resulting period of oscillations also equals $t_1 = t_2$. But if t_1 and t_2 are different, then the resulting period of oscillations has a value between t_1 and t_2 and is generally nearer to the value of the smaller machine. This is of importance, for instance, if the case of two machines of equal capacity, for one of which $t \div T = 0.7$ and for the other $t \div T = 1.3$.

Both values taken alone are satisfactory. But when both machines are to work in parallel $t \div T$ will be approximately unity and there will be resonance trouble. This should be taken into consideration when manufacturers guarantee good parallel operation. Before doing so they should know the value of t of the existing machines with which the new machines have to work in parallel, or they should know at least whether for the existing machines $t \div T$ is greater or smaller than unity. The author finally describes a simple method for preventing oscillation troubles which has proved satisfactory especially with small rotary converters connected to small transformers, for which the danger of oscillations is great on account of the large ohmic voltage drop. He places loosely on the axle of the machine a flywheel which is tuned to the period t. It is not rigidly connected with the axle, but loosely by means of springs. When properly dimensioned this flywheel will make oscillations differing in time-phase by 180 deg. from the disturbing impulses and will thus compensate them.—*Elek. Zeit.*, Nov. 30.

Short-Circuits of Alternators.—P. Boucherot.—A discussion of the electric phenomena which result from a sudden short-circuit of an alternator. As a result of the development of the turbo-alternator with its high speed, small magnetic stray fluxes and large effects of short circuits the problems of sudden short-circuits have become of importance. The author first discusses the different induction coefficients which are to be considered in the circuits of an alternator and then discusses sudden polyphase short-circuits, sudden single-phase short-circuits, and finally partial short-circuits. The article is illustrated by oscillographs.—*La Lumière Elec.*, Dec. 2.

Alternating-Current Turbo-Dynamos.—A. Thomaelen.—A profusely illustrated description of various features of the mechanical construction of alternating-current turbo-generators of the Siemens-Schuckert company.—*Elek. Zeit.*, Nov. 30.

Lamps and Lighting.

Filament Supports.—A note on a recent British patent (No. 26667, Nov. 30, 1911) of E. R. Grote, who uses a mica disk instead of platinum or iridium wire for the filament support. Thin mica disks attached to the central rod are perforated at regular intervals along the edges to take the filaments and are slit radially between each pair of filaments to render them elastic. The upper disk is provided with conductors for joining each adjacent pair of filaments together. Instead of slitting the disks, they may be mounted with springs above and below the point of support, or mica rings held in spring-wire supports may be used instead of the disks.—Lond. *Elec. Eng'ing*, Dec. 7.

Generation, Transmission and Distribution.

Generating Station at Coal Mine.—A. Feldsmann.—The first part of an illustrated description of the electric plant at the bituminous coal mines near Hamberg on the Rhine, in Germany. At three of the pits electrical energy is generated from the excess of coke-oven gases which is not used for heating the coke ovens. There are four gas engines, one steam engine and three steam turbines having an aggregate rating of 10,700 kw. The generating emf is 5000 volts. The transmission voltages are 5000 to 10,000. The paper is to be concluded.—*Elek. Zeit.*, Dec. 7.

Single-Phase Commutator Motor for Printing Presses.—E. Piernet.—An illustrated article on the use of the Deri single-phase commutator motor, which is a repulsion motor with several pairs of brushes short-circuited. Speed regulation is obtained by displacement of one set on the brushes. In the present articles the use of this motor for driving presses is especially discussed and diagrams are given showing characteristic test curves of the motor.—*La Revue Elec.*, Dec. 8.

Traction.

London.—An abstract of last year's financial report of the underground railways of London.—Lond. *Electrician*, Dec. 8.

Installations, Systems and Appliances.

Rates and Popularity of Electric Light.—Kraetzer.—The author emphasizes that of the propositions made to increase the popularity of electric light none has proved more successful than that to facilitate the first installation. The author gives the results of several small central stations which make the first installation free of charge to the consumer. Niederramstadt is a suburb of Darmstadt, with 2000 inhabitants, of whom two-thirds are workingmen. In the very first year not less than 3000 lamps have been installed with 300 meters. The rate is 12.5 cents per kw-hour and a monthly rent of from 5 cents to 75 cents per meter. Use is made of electrolytic meters, which have proved very successful. The difference between the master meter in the central station and the sum of the readings of the electrolytic meters at the consumers' premises is only about 5 per cent for the whole year. Out of 300 consumers, 27 consumed more than $12.50 during the last year, 40 consumed between $7.50 and $12.50, 60 consumed between $5 and $7.50, 65 consumed between $3.75 and $5, and 108 consumed less than $3.75 worth of electrical energy. Thus, in spite of a 12.5-cent per kilowatt-hour rate, more than half of the consumers spent less than $5 per year. The 16-cp metallic-filament lamp is largely used. The net earnings of the central station during the first year were 7 per cent. In the city of Dillenburg, in Hessen, with 5000 inhabitants, where there is a municipal gas plant, the municipality has also undertaken the sale of electrical energy, buying the energy in bulk from a transmission system and distributing it at 3×120 volts. The city paid during the first year for the installation of two lamps for every consumer who wanted them. As a compensation the consumer had to guarantee that he would buy for five years at least $4.50 worth of energy yearly. The consumer may select his own wireman, but he must have a license in the city. This method was successful beyond expectations. In the first year 500 meters and 4000 lamps were installed. The net earnings of the electrical department in the first year were almost $1,500. On the other hand, the net earnings of the gas plant were reduced by $1,000 to $2,625. The net earnings of the two departments together are, however, now greater than those of the gas plant before alone. In a small out-of-town place, Baumholder, with 1700 inhabitants, a generating plant has been installed with two Diesel engines of 40 hp and 25 hp, and electric energy is distributed at 2×120 volts. The wiring of the residences and installation of two lamps per meter are paid for by the township. Energy totaling 27,500 kw-hours was furnished to the busbars, and the sum of the readings of the electrolytic meters showed a consumption of 26,400 kw-hours. The tariff is 12.5 cents per kw-hour and 6.25 cents meter rent per month. Out of 278 living houses, 258 are connected to the station, with 2233 lamps and seven motors. In connection with the generating plant there is a bath-house in which the exhaust heat of the Diesel engines is utilized. The total first cost was $3500. After deducting interest and amortization the net earnings in the first year were $925. The use of kerosene seems to have been almost given up even in small residences in this town.—*Elek. Zeit.*, Nov. 30.

Tariff.—H. Bergmann.—An account of the rates charged for electrical energy by the upper Silesian electricity works, which are one of the few German generating stations which have not changed their tariff since they began operation. The rate is based essentially on the cost of generating the energy and considers both the maximum load and the yearly hours of using the energy. To large consumers discounts are allowed according to the yearly bill. For small consumers flat rates are charged, which are based on an assumed number of 1500 hours of use of electricity per year. Out of 15,750 consumers there are 9818

using flat rates. They have no meters, but limiting devices which limit the amount of power taken from the supply network. Out of these 9819 flat-rate consumers, 772 use from 30 to 50 watts, 2852 use from 50 to 100 watts, 2345 use from 100 to 150 watts, 1333 use from 150 to 200 watts, and 2516 use from 200 to 2500 watts. The consumption of electrical energy per capita is much higher in upper Silesia than anywhere else in Germany, even in the largest cities. The consumption of gas for lighting is losing ground in upper Silesia.—*Elek. Zeit.*, Nov. 30.

Automatic Reversible Battery Boosters.—R. RANKIN.—The conclusion of his paper read before the (British) Institution of Electrical Engineers discussing the uses and advantages of a battery-booster plant and the savings likely to be effected by its employment. Boosters are classified under three main divisions. Under class A are described the plain differential, Pirani, Crompton and Lancashire systems; under class B are the Highfield and E. C. C. systems. The advantages of boosters controlled by external regulators over those of the diverter type are briefly mentioned. Such boosters belong to class C, which includes the Entz, B. T. H., Taylor-Scotson, Tilney and Brown-Boveri boosters, while the systems of Lincoln and Bijur are also referred to. The conclusions of the author are as follows: In the installation of a battery and booster on a highly fluctuating load, both the generator and battery are operated under satisfactory conditions, for batteries working under such circumstances usually remain in very good order indeed. With regard to boosters there can be little difference between the actual results obtained from the use of those of class B and the Lancashire booster in class A. The author thinks that the other members of class A described in the paper certainly cannot be so satisfactory as those referred to. Boosters of class A and class B must be more sluggish in action than those of class C, certainly more than those of this class in which an overshooting effect, suitably checked, can be arranged for. Where considerations of field copper are the cause of an exciter being used with a class A booster the sluggishness becomes still more pronounced. The main factor causing the lag in diverter boosters is the use of the diverter itself. When a variation—say, an increase—in line current occurs the first increment must perforce come from the generator, and, the diverter being non-inductive, this increment may be, and usually is, very considerable. It is obvious, too, that throughout the entire action the booster voltage is dependent on a previous variation in line current, and the above-mentioned effect has continually to be reckoned with. This will help to make it clear why lamination of the entire field system of such boosters is considered by many to be absolutely essential. With regard to the respective merits of boosters in class C the authors have little to say as far as regulation obtained is concerned, the Entz booster being the only one which has been used to any extent in England, and it is said that it possesses the great advantage of extreme simplicity and the other equally important advantage that it employs no moving electrical contacts.—Lond. *Electrician*, Dec. 1.

Electrophysics and Magnetism.

Thermal Conductivity at High Temperatures.—M. F. ANGELL.—The author gives an account of measurements of heat conductivities at high temperatures, using a method in which the flow of heat from the electrically heated inside of a long cylinder to its outside was determined. The results of determinations of the thermal conductivity of nickel between 300 deg. C. and 1200 deg. C. and of aluminum between 100 deg. C. and 600 deg. C. are given. There is no constant ratio between electrical and thermal conductivities for these metals at high temperatures. At high temperatures the thermal conductivity of aluminum increases, and of nickel up to 700 deg. C. decreases, more rapidly than from 0 deg. C. to 100 deg. C.; above 700 deg. C. the thermal conductivity of nickel decreases very slowly up to 1225 deg. C. A third allotropic state for nickel exists at about 700 deg. C., with a change in the form of the electrical and thermal conductivity curves at this point. The magnetic critical temperature of nickel is shifted through a range of 130 deg. by heat treatment, annealing from high temperatures giving a low value and sudden cooling, producing values as high as 420 deg. C. The results are given of determinations of the electrical resistance of nickel between 0 deg. C. and 1200 deg. C. and of aluminum between 0 deg. C. and 600 deg. C.—*Phys. Review*, November.

Selenium.—F. C. BROWN.—The author has formerly shown that the general behavior of the four known varieties of selenium under the action of light could be explained by assuming that the different varieties were merely differently proportioned mixtures of three components in equilibrium with each other. Whereas it was shown in his former paper that the general behavior of all the known varieties of light-positive and light-negative selenium could be explained by the proposed theory, it is shown in the present paper for one of the light-positive varieties, namely, that found in the Giltay selenium cell, that the change of conductivity during both exposure and recovery can be explained quite accurately by the same theory. Only one of the three components is conducting. Very direct experiments show that for at least one case the change in the conductivity is proportional to the amount of the changing component. Temperature action in the Giltay selenium cell is essentially the same as light action, but not identical with it.—*Phys. Rev.*, November.

Photoelectric Effect Caused by Incident and Emergent Light.—O. STUHLMANN.—If the metals are arranged in the order of their atomic weights and also according to their position in the periodic system, there is a periodic increase in the ratio of the emergent to the incident photoelectric effect as one ascends through the periods of the table. It would seem that the ratio has a constant value in each period, although this is hardly a universal law. Since it is known that the incident photoelectric effect increases with decreasing wave-length of the incident light, it may be that the ratio of the emergent to the incident effect would be constant for monochromatic light, so that the present variations in the above ratio of emergent to incident effect for the various metals might be attributed to a selective photoelectric activity on the part of the films used.—*Phil. Mag.*, December.

Radium.—H. LIEBER.—The author first gives a brief summary of the properties of radium and its emanations and then describes his method of "radium coatings," which permits the use of only small amounts of radium to yield all the emanations and the radiations for physiological or any other purpose desired.—*Jour. Franklin Inst.*, December.

Electrochemistry and Batteries.

Electroplating.—A note on the Marino plating process, which permits electrodeposits on china and other non-conductors. The articles to be plated, say, a china teapot, has its surface roughened by a sand blast and is then painted with a paste consisting of a mixture of the chloride, or other salt, of the metal to be deposited and hydrofluoric acid. This mixture is said to form what may be termed a preparative surface on which metal can be deposited from an electrolytic bath by the usual means. In this way a thick plate of metal is obtained, which can be polished and worked, while at the same time it considerably increases the strength of the china interior. This arrangement, it is claimed, also makes the cold galvanizing of such articles as screws, chains and other machine parts possible at a less cost than the present process.—Lond. *Electrician*, Dec. 8.

Reduction of Nitrobenzine.—R. C. SNOWDEN.—An account of an experimental investigation the chief results of which are as follows: Nitrobenzine can be reduced elec-

trolytically to aniline in ferrous chloride solution at 100 deg. C. between iron electrodes. For a current density of 15 amp per square decimeter only 2.2 volts is needed. Massive iron reacts chemically with nitrobenzine and aqueous ferrous chloride at 100 deg., provided the stirring is sufficiently intense to bring all these substances into intimate contact. The presence of an iron salt, preferably ferrous chloride, seems to be essential. The rate of corrosion of the iron depends on the concentration of the iron salt, but is not proportional to it. The concentration of the ferrous chloride remains unchanged throughout the run. The catalytic action of ferrous chloride is apparently due to its being a reducing agent and to its keeping the iron from becoming passive. Nitrobenzine is reduced at 100 deg. by alkaline sodium sulphide, ferrous hydroxide and sodium arsenite solutions, but not by alkaline potassium ferrocyanide solution. With sodium sulphide a yield of from 92 to 97 per cent. aniline can be obtained; with ferrous hydroxide a yield of from 60 to 80 per cent aniline is obtained; with sodium arsenite the chief product is azoxybenzine, of which a 90 per cent yield can be obtained—*Journal Phys. Chemistry,* December.

Chemical Elements.—J. W. Nicholson.—A paper giving a preliminary account of a structural theory of the chemical elements, which derives them as compounds, in a certain sense, of primary forms of matter. The simple elements from which, or rather from the constituents of which, the author proposes to construct all the others consist of single rings of electrons rotating round small nuclei of positive electricity. These nuclei are small compared with the electron and furnish nearly the whole mass of the atom. The weight of an atom, always determined from its inertia, is regarded as the sum of the inertias of all its positive and negative charges.—*Phil. Mag.,* December.

Units, Measurements and Instruments.

Inductance of Linear Conductors.—A. C. Jolley ,nd A. F. Burgess.—The conclusion of their paper giving the results of an experimental determination of the inductance of linear conductors. The chief conclusion reached is that the Neumann formula applies only to the field whose principal section is an area extending from the axis of the conductor to infinity, and which is literally bounded by two normals to the axis at a distance apart equal to the length of the conductor, and that it does not, when applied to a finite conductor, take account of the magnetic field extending beyond the ends of the conductor, and hence the values for such cases calculated by it will be too low. The method of direct integration employed by the authors gives results which agree with the experimental facts with considerable precision. Considerable masses of iron do not affect the value of the inductance of a finite conductor if situated at a distance greater than 10 cm from it, provided that they do not form closed, or approximately closed, magnetic circuits about the conductor. Placing the conductor in an open or semi-closed slot increases the inductance, which then becomes virtually independent of the current in the conductor, but is dependent upon its position in the slot. The same conductor in a tunnel which completes the magnetic circuit through a narrow iron bridge has an inductance which depends to a very considerable extent upon the conductor current and hardly at all upon its position in the slot. The presence of polar iron causes a further increase in the inductance, dependent upon the length of the air-gap, the conductor current again becoming an important factor. The magnetic saturation of the teeth causes considerable variation in the inductance in all cases, a rapid fall being shown as the saturation increases, but in all cases tending toward a limiting value of five lines per centimeter per ampere.—Lond. *Electrician,* Dec. 8.

Thermopile.—W. W. Coblentz.—An illustrated article on a bismuth-silver thermopile. The thermoelectric emf of the bismuth-silver thermocouple is 89 microvolts per degree, as compared with an iron-constantan couple, which is from 51 to 53 microvolts per degree. The temperature sensitivity of Bi-Ag is, therefore, about 74 per cent greater than an iron-constantan thermopile. Whether the radiation sensitivity is increased in like proportion will depend upon the selection of the proper diameters of wires. In the present case the radiation sensitivity of the bismuth-silver thermocouple is two to three times that of the constantan pile. Details of construction are given.—*Jour. Franklin Inst.,* December.

Measuring Temperature.—J. Rautenkranz.—A paper describing various types of electrical instruments for measuring temperature, including (1) resistance thermometers, (2) thermoelectric pyrometers, and (3) instruments depending on optical effects.—Lond. *Electrician,* Dec. 8.

Meter.—An official communication of the Reichsanstalt on a new construction of the rotating direct-current motor meter of the Allgemeine Elektricitäts Gesellschaft. The construction of the meter is described and illustrated in diagrams and the method of calibrating it and the properties of the meter are dealt with.—*Elek. Zeit.,* Nov. 30.

Telegraphy, Telephony and Signals.

Wireless Telegraphy in Balloons.—Mosler.—An account of experiments made on a German balloon concerning the best arrangement of the receiving wire. Great precautions must be taken to prevent explosions due to sparks. Messages were received with certainty and clearness over distances of 1000 km (600 miles). It also seems that the intensity of the receiving current is practically independent of the height of the balloon, at least within the limits of the heights employed in aeronautics. If a balloon which receives a message at a low height has to rise quickly, it will, therefore, be able to continue receiving the message with the same intensity. The decrease of the intensity of the electromagnetic waves with distance appears to be directly proportional to the distance.—*Elek. Zeit.,* Nov. 30.

Miscellaneous.

Exhibition.—C. Paulus.—The first part of a description of the exhibits at last summer's exhibition in Munich on uses of electricity in households, in small workshops and in agriculture. In the present instalment the author deals with exhibits relating to telephony, signals, fire alarms and burglar alarms, electric clocks, the uses of electricity in therapeutics, measuring instruments, automatic switches (for instance, for closing and opening lighting circuits at certain predetermined hours) and wiring installations.—*Elek. Zeit.,* Nov. 30.

Hygiene Exposition.—Heilbrun.—A review of the various electrical apparatus in the different departments of the hygiene exposition recently held in Dresden. Applications of electricity were made for lighting, heating, motor service and therapeutic purposes.—*Elek. Zeit.,* Dec. 7.

Book Review.

Magnetismo e Elettricita. By Francesco Grassi. Milan: Ulrico Hoepli. 878 pages, 398 illus. Price, 7.50 lire. Fourth edition.

A good elementary treatise on applied electricity and magnetism, which occupies an intermediate position between a book on descriptive physics and a book on descriptive electrical engineering. Mathematics is hardly employed. Nevertheless, a good general insight is offered in the sciences of experimental magnetics, electrics and electromagnetics, as well as in their relation to electrical engineering. The work is divided into thirty chapters, of which the first half relate to the fundamental sciences and the second half to the engineering applications. The chapters on terrestrial magnetism and on radioactivity are particularly well treated.

New Apparatus and Appliances

THE COMMERCIAL VALUE OF THE MAXIMUM-DEMAND-INDICATOR SYSTEM.

BY A. G. RAKESTRAW.

The question of rates for electric service has recently been the subject of investigation and analysis by the rate research committee of the National Electric Light Association, and much space has been devoted to a discussion of the problem in the technical press. The rather sudden interest of central stations in the rate question has been largely precipitated by the rapid introduction of the tungsten lamps and the loss of revenue which was feared as a result.

It is true that the increased use of light due to the new lamps soon more than compensated for the reduction of energy taken, but the effect has been to bring the subject of rate analysis to the attention of central-station managers. One fact which was at once recognized was that so far no adequate provision had been made for the fixed charges or the cost of supplying the service, and, as a consequence, any increase in the efficiency of lamps or other apparatus, while reducing the cost to the customer just that much, does not reduce the cost of supplying him in the same proportion. Since in most cases the fixed charges are a large share of the total expense, it becomes absolutely necessary that the rates be adjusted to take care of this item.

The problem, therefore, is to devise a system which, without being too complicated, shall equitably take into account the various factors entering into the cost of electric service, and which shall be flexible enough to meet different conditions, while being attractive to the customer.

The old flat rate and the straight meter rate have both been recognized as inadequate for these purposes and there have been many other plans suggested of more or less value. One common plan is to give varying discounts according to the size of bill. Another is to give different meter rates according to the guaranteed monthly consumption, and still another is the two-rate system, either with or without the use of the maximum-demand indicator. A fourth plan which has received a good deal of attention and has been introduced in many places is the controlled flat rate with the use of the "Excess" indicator. So far this system has been used almost exclusively for residences, though a few companies have extended it to small commercial business.

With the "Excess" indicator the demand is limited, but the hours of burning are not. The customer may have any number of lamps in the house, but makes a contract for a certain demand, say 100 watts, which will permit him to use four 25-watt tungsten lamps anywhere at any one time; but if more than this number are turned on the indicator will automatically interrupt the circuit, turning the power off and on at frequent intervals until the excess demand ceases. The customer is usually limited to the use of tungsten lamps, for his own benefit, for although carbon-filament lamps can be used if desired, yet because they take so much more current the results would be anything but satisfactory to him.

Neglecting any discussion as to the equity of this rate, it may be interesting to consider some of the practical results secured by the use of this device. The writer, as contract agent of the Harrisburg (Pa.) Light, Heat & Power Company, has assisted in inaugurating and conducting a "new-business" campaign with the aid of the "Excess" indicator, the results of which have been both productive and instructive. In the first place, from the customer's point of view, it is certainly a great satisfaction to know what one's electric-light bill will amount to. Many customers will submit to even a small increase in the guaranteed amount of consumption for the sake of immunity from worry as to the probable winter bills; and since the customer does not have to worry over the possibility (and frequently the reality) of high bills, and since he is not constantly suspicious of the accuracy of the meter, his relations with the company are apt to be more pleasant.

Furthermore, since in most instances the use of the tungsten lamp is compulsory, this very fact enables him to secure more light for the same outlay than would be possible under any other system. We have found that our residence customers using the controlled flat rate always have well-lighted houses, which in itself is perhaps as good an advertisement as the lighting company could have. The statement sometimes made, that since the customer has to pay for his own lamp renewals he will be careful to economize in the hours of burning for the sake of saving the lamps, I do not believe to be founded on fact. We find that our flat-rate customers use the light very freely, though not, as a rule, extravagantly.

Another advantage to the customer is that the "Excess" indicator does not have to be read monthly, and this relieves the housewife of much inconvenience, especially in winter time, when mud and snow are likely to be tramped through the house. This is particularly an advantage in case the meter happens to be in the attic or some other place difficult of access.

From the standpoint of the central station, we are relieved of the expense of meter reading, testing, repairing, calculation of the bills, as well as the loss of revenue from slow meters, which may be considerable. It is also a source of satisfaction to be relieved of the necessity of attending to high-bill complaints, which otherwise are sure to come in and which call for check readings, special tests and frequently rebates in order to keep the good will of the customer, and sometimes necessitate the removal of the service altogether on account of refusal to pay an unusually high bill.

Our experience has been that it is possible to secure a large number of customers on this basis that we could not get in any other way. The proposition appeals to them. Some central-station managers, while admitting this to be true, have looked upon the controlled flat-rate system as a sort of bait with which to get customers on the line with a view finally to changing them over to meters. While it is true that the new business attracted by the "Excess" indicator consists largely of persons who have not heretofore used electric light, and while undoubtedly some of these will eventually use meters, yet I do not think that the indicator should be looked upon in this light, as there is a great deal of business within the reach of every central station which could not only be secured, but profitably retained, on this basis. We have also quite a few customers now on the flat rate who formerly used meters, but who discontinued the latter service on account of high bills or for a similar reason.

We have found, under the local conditions obtaining, that, when the two systems are impartially explained to prospective customers, of those who have previously been users of electricity about half will choose each plan, but of those who have previously been using oil or gas a large majority choose the "Excess" indicator.

Were it not for the complications caused by the demand for heating, cooking and other appliances, I believe the

controlled flat rate would be ideal for residence use. As it is, I believe that we should make efforts toward perfecting some system by which these appliances may be used on a special flat rate, in connection with the indicator; for it is quite certain that the neglect to do this will serve as a restraint upon their use, as there are quite a number of flat-rate customers who will postpone the purchase of electric irons, washers, cleaners, sewing-machine motors, and other such articles, rather than give up the benefits of the "Excess" indicator.

In regard to changing from meters to indicators by present customers, I would say that we have had quite a number of requests for such changes. While we have not refused any of them, yet we have rather discouraged any such change except where it clearly appears that the indicator is what the customer needs and ought to have. The majority of our meter customers are used to that system; most of them are using some kind of appliances, and it is almost certain that if they were encouraged to change over in large numbers it would not be long before a great many would want their meters back again, thus entailing needless expense upon the central station. The number of changes from meter to indicator and from indicator to meter has been trifling as compared with the total business secured.

In general, I feel that the "Excess" indicator is of great commercial value to the central station, bringing in a large revenue per unit of demand; and while the gross revenue may be somewhat smaller per customer, yet this will be more than offset by the increased number of customers which it is possible to serve with the same plant and line equipment. As applied to residence business, it certainly does a great deal toward making the use of electric light universal, and every customer added to the line is a standing advertisement. Our customers who have this system are all well pleased. They talk to their friends and neighbors, and we can trace a considerable amount of unsolicited new business to this source.

THE RECONSTRUCTION OF A 20,000-HP HYDRO-ELECTRIC PLANT.

The Borel plant of the Pacific Light & Power Company, Los Angeles, possesses several features of interest, especially with reference to the development and installation of modern water turbines. The plant, which is located on the Kern River, consists of five 2500-kw Bullock generators, which are waterwheel-driven and form a part of the generating system of the above company, furnishing Los Angeles with electricity through upward of 150 miles of transmission line. The water for driving the turbines is carried through a cemented canal 12 miles long to a forebay located directly above the power house. In this way a drop of 260 ft. is created. The water is taken from the forebay through five 5-ft. steel pipes each 500 ft. long to the turbines. The plant is reached by an old mountain road 35 miles long which attains an altitude of 4000 ft., and the plant itself has an elevation of 2500 ft. above sea level.

The original installation of the plant consisted of five impulse turbines of the Girard type. The wheels were mounted overhung on the 16-in. shaft extension of the generators, and the speed of the wheels was 231 r.p.m. As the power house is located on a bank about 25 ft. above the river, the wheels were provided with draft tubes, and by means of an air inlet into the casing, which was regulated through a float valve in the tailrace, the water in the draft tube was to be kept a certain distance below the wheels. After about four years' operation it was decided to take the Girard turbines out, as they did not operate at the desired high efficiency.

The Pelton Water Wheel Company, of San Francisco, was awarded the contract for four Pelton-Francis units, the purchaser taking the precaution to have the first unit built and installed and very thoroughly tested, in compliance with guarantees, before authorizing the manufacture of the other three units. In the design of these turbines a runner of rather large diameter (84 in.) was

Fig. 1—Borel Power Station.

necessary, thus making the surface friction and runner and casing clearances rather critical. In other words, the runner is of necessity what is known as an extremely low-speed type for the attainment of best efficiencies. The large diameter of the runner of course makes necessary a large diameter of spiral casing weighing upward of 30,000 lb. and standing 16.5 ft. high. This is parted horizontally. The flow of water to the turbine may be controlled by a 42-in. hydraulically operated gate valve. The water passage to the runner is under the control of thirty-two cast-steel wicket gates or guide vanes outside packed and of carefully determined curvature, to insure good efficiencies at fractional loads. A cast-steel gate ring actuated by the governor controls the synchronous movement of these wicket gates through suitable levers and links. The turbine runner is of manganese bronze and great care was taken in the molding to insure smooth surfaces, the instrument being hand-scraped and machined with this object in view. The runner is hydraulically balanced by means of balance chambers on each side, but a double disk thrust bearing with automatic ring oiling supply is also provided. The runner discharge occurs over a fixed conical thimble surrounding and protecting the shaft and extending into the draft elbow. The reaction from the runner is thus taken up by this stationary discharge thimble, which reduces the end thrust on the bearing. The draft tube ex-

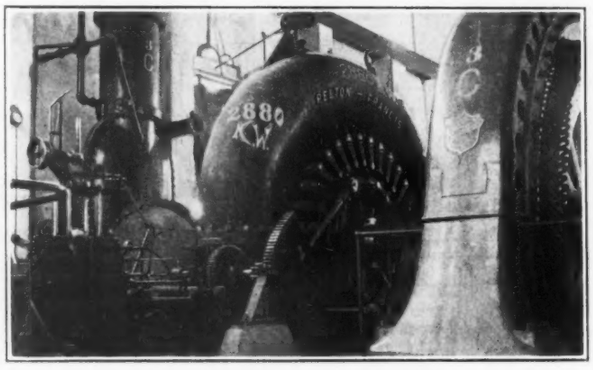


Fig. 2—Turbine at Plant Showing Governor Connections.

tends from the flange outlet of the draft elbow a distance of 27 ft. below the shaft center line, flaring suitably to reduce the discharge velocity to a minimum. The casing covers are made parting to facilitate access. The shaft where it extends through the packing glands is protected from wear by a suitable parting bronze wearing shield, which can be

readily replaced. The water passage between the wicket gates and runner is protected by bronze liner plates readily replaceable in the event of wear. Aside from the adjustment provided for the wicket gates, the connecting rods between the gate ring and governor rockshaft are adjustable.

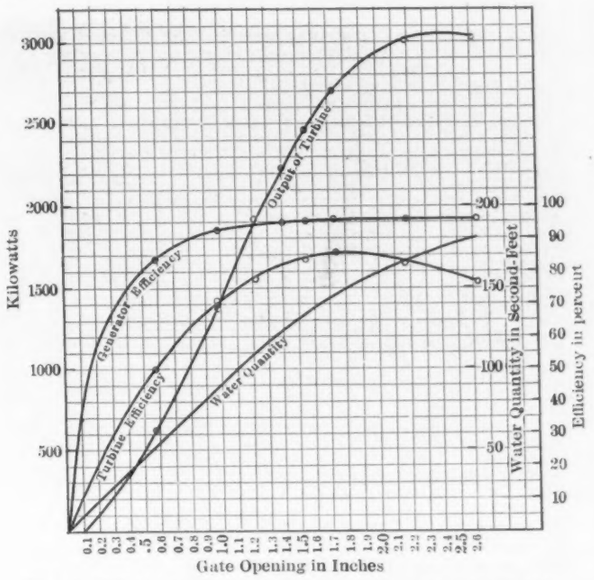


Fig. 3—Efficiency Test of 4000-hp Pelton-Francis Turbine.

In most installations a synchronously operated relief valve is directly connected to the rockshaft to prevent water ram in the pipe line on the governor's action at load changes. In this particular plant, however, the governor works directly on the wicket gates, but is set to make the stroke slow enough to prevent a material rise of pressure in the short pipe line.

The first unit was completed and installed in March, 1911, and on April 21 and 22 an elaborate test was made by Mr. James H. Wise, representing J. G. White & Company, acting hydraulic engineers for purchaser. The efficiency was found to exceed the guarantees, the maximum efficiency being 85.5 per cent, and the construction of the other three units was started at once. A record of the test is indicated in Fig. 3. The generator tested was paralleled with the transmission line and partly loaded, but it was found that its voltage could not be raised above 2000 volts with a unity power factor on the generator. As it was desirable to run the test with as near the normal terminal voltage of 2200 for the generator as possible, a second generator was also paralleled with the transmission line. Then the water of the turbine of this unit was shut off, allowing the generator to float on the line; by over-exciting its field the transmission voltage was raised, so that the generator under test could be run at practically nominal terminal voltage. All the other generators were shut down during the entire test.

In order to determine the iron loss and the friction and windage losses, both of the generators were connected to the transmission line and then the water was shut off from one generator and both generators were then disconnected from the transmission line. In this way the generator under test was run as a synchronous motor and was given an increased field excitation for each point of the test. The voltage of the driving generator was varied so as to give a unity power-factor input to the synchronous motor. The speed of the driving generator was held at the value corresponding to 50 cycles by operating the turbine gates manually. From the curves of Fig. 3 it will be seen that the maximum efficiency of the generators ran as high as 95.7 per cent at full load and 92 per cent at half load.

The above test results show that a reaction turbine can give excellent results and high efficiencies under extremely unfavorable conditions, where even impulse wheels have been considered.

A MODERN ELECTRICALLY OPERATED BRICK PLANT.

By O. F. Metz.

One of the most modern electrically driven brick plants is that of the Oakland Paving Brick Company, to which the accompanying illustrations refer. This is said to be the largest paving-brick plant in the United States, having a capacity of 100,000 paving bricks per day. Its total capacity is 200,000 of all kinds of bricks per day. The plant is located near Niles, Cal., in the beautiful and prosperous country touching the Coast Range foothills, on the east shore of San Francisco Bay. Plenty of good clay is at hand here, requiring only to be opened up by the removal of 3 ft. of the rich top-soil.

The brick-plant building is of mill construction, covered with corrugated iron, and has the shape of an L, with its longer member 1000 ft. in length. A runway carries a 10-ton, 62-ft. traveling crane, which serves the entire building. This crane is operated by 220-volt alternating-current motors, and was built by the American Clay Machinery Company, which also furnished all the brick-making machinery. The plant is electrically driven throughout and is also lighted by electricity. Many new and interesting features have been introduced, as shown by the accompanying illustration, which will give some idea of the completeness of the details.

The electrical equipment, which was furnished entirely by the Allis-Chalmers Company, includes motors, controlling apparatus and transformers. Practically all the motors are of the 2200-volt induction type, which has been used very extensively in cement mills, crushing plants, brick factories, and other places where there is a large amount of dust, in all cases giving extremely good service. Motors of lower voltage have frequently been employed, mainly because they were believed to be somewhat safer for the operatives, but it has been found that where proper care is taken in the installation there is no serious danger from this source. A very considerable saving of wiring copper is effected, and the cost of step-down transformers is saved in many cases.

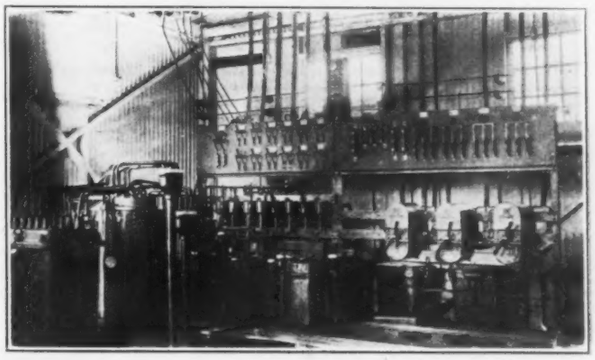


Fig. 1—Interior of Substation Showing Transformers and Starters for 2300-Volt Induction Motors.

Energy is delivered to the plant by the Pacific Gas & Electric Company over a 60,000-volt, three-phase transmission line. Outside the substation, which is adjacent to the main plant building, is a heavy framework which carries the terminal insulators, air-brake switches and pole-top fuses. From this framework the high-tension lines

are carried into the substation to the 60,000-2300-volt oil-filled, water-cooled transformers, the secondaries of which feed directly to the starters for the 2200-volt motors and to the primaries of the low-voltage transformers, which step down to 220 volts for the potential starters controlling the crane-type low-voltage motors. All of the motors in the plant, with the exception, of course, of those on the cranes, are controlled directly from the substation. An annunciator in the switch house is connected by a bell circuit to push-buttons at each motor, so that by a system of signals the machine operator can notify the switch attendant when to start or stop a motor. All the starting and switching apparatus is thus kept in an atmosphere free from dust, and under the care of a single skilled electrician. All wiring is carried in metal conduits.

The lighting of the plant is in general by means of lamp standards placed beside the machine and protected by lamp guards. This arrangement leaves all overhead space free for the movement of the cranes. In parts of the building where cranes do not operate drop cords or conduit is used.

The plant has been located quite near the clay pits. At present the top layer of earth is removed from the clay deposits by a horse-drawn scraper, the same means being used to excavate the clay. It is planned later to install an electric shovel for this work as soon as the plant is in full operation. From the hopper into which the clay is dumped a belt conveyor carries the material to a 24-in. disintegrator, where it is thoroughly broken up. From the disintegrator a chain conveyor then carries the finely divided clay to a hopper above the pug mill into which it is fed as needed. Here it is finely ground and mixed with a suitable amount of water to give the consistency for making brick. From the pug mill the clay mixture is discharged into a brick machine, immediately below it, in which dies form the brick to its approximate dimensions. The green bricks are then delivered to a rotary cutter which trims them to exact size. An off-bearing conveyor belt thence delivers the paving brick to the front of a row of four automatic re-presses into which they are fed by hand. Common red building brick or sewer brick require no re-pressing, the bricks being taken by hand directly from the conveyor and piled in units of 500. All rejections are left on the conveyor belt, to be dropped from its end into a

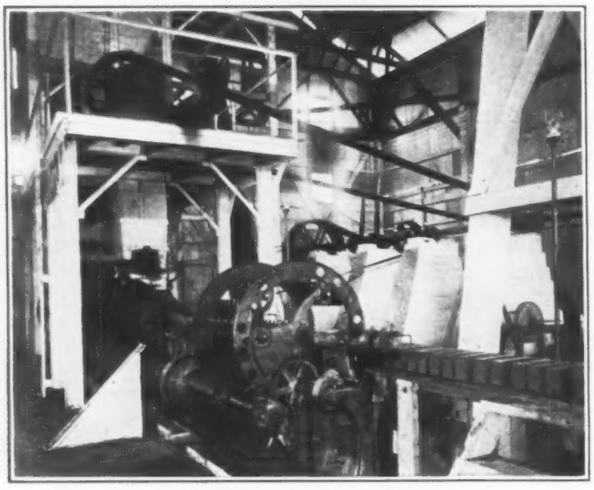


Fig. 2—Brick Machine and Rotary Cutter.

second conveyor beneath the floor, which returns them to the pug mill. All of the machinery thus far mentioned, together with the connecting conveyors, is driven from a line shaft, which in turn is operated by a 250-hp motor.

One of the greatest labor-saving devices in the plant is the automatic brick-setting machine, by which the crane picks up the bricks in units of 500 and stacks them in a double, continuous drier. Each of these concrete driers holds 150,000 bricks. Wooden covers borne on wheels close the tops of the driers. After the driers are filled with brick and closed hot air is blown in through bottom apertures by a 20-ft. fan driven by an adjustable-speed motor.

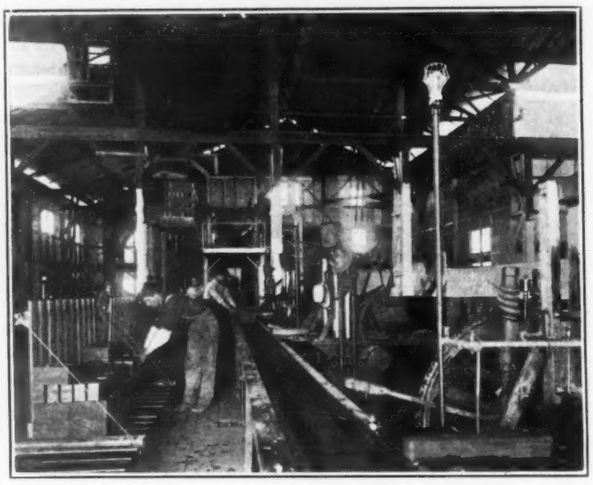


Fig. 3—Automatic Re-presses.

This speed control enables the amount of air supplied to be regulated at will. Two 7-ft. disk fans, driven by 10-hp constant-speed motors, draw the moist air from the driers.

Crude oil is used throughout the plant for heating purposes. A duplex 14-in. by 10-in. Clayton air compressor, driven by a 50-hp induction motor, furnishes all the air needed for various purposes, including that used for atomizing the oil in the burner for the kilns and hot-air furnaces. Compressed air is also utilized for blowing the dust from the motors and for cleaning the dies and presses.

After drying for twenty-four hours the bricks are removed from the drier again by the brick-setting machines and stacked in the kilns in similar units of 500. As soon as they are thoroughly burned the brick-setting machines are again brought into play and the bricks removed to be cooled and finally loaded on cars. Through the use of these machines it is thus seen that the minimum amount of labor is employed in handling the brick. The only points at which they are individually handled are where they are fed into the presses, stacked upon the brick-setting trays, or piled in the cars. This means a very great reduction in the expense of operation.

The bricks broken in the driers or kilns are later ground up in a 9-ft. dry pan, driven by a 40-hp motor. From here they are delivered to the pug mill, where they are again worked up into brick. This method of handling, of course, greatly reduces the waste.

A 6000-gal. oil tank located a little distance from the plant stores sufficient fuel oil to operate it for long periods. It also makes possible the purchase of oil in large quantities, securing a correspondingly better price. The oil is delivered from the tank by three Gould oil pumps driven by a 10-hp motor. The same motor also drives a deep-well water pump which supplies all the water needed about the works.

This California plant has now been in operation for about a year and has given complete satisfaction in every detail. The owners are reported to be highly gratified at the success attending their choice of apparatus and their decision to use electric drive throughout. The president of the Oakland Paving Brick Company is Mr. L. G. Burpe, and the vice-president is Mr. E. A. Heron, who is president of the Oakland Consolidated Traction Company. The secretary and treasurer is Mr. D. K. Halloway.

Industrial and Commercial News

THE WEEK IN TRADE.

WITH attention directed, as is customary at this time, toward the taking of inventories, the compiling of the results of the year's operation in many cases, and with planning for the coming year, business transactions in the majority of lines have shown a slight curtailment during the week. Retail lines are still reflecting the activity of the holiday season, and the turnover in this direction is close to the normal. The buying of steel throughout the holidays has been greatly beyond expectations, and has contributed to an important degree in making the fourth quarter in the steel business the most satisfactory of the year. Railroad interest in the steel markets is unabated, and orders for fair tonnages for 1912 delivery are now pending from this source. The plants of the Steel Corporation are understood to be operating at approximately 80 per cent of capacity, and with continuation of the present rate of buying increase to nearly 85 per cent in the early part of 1912 is probable. The pig-iron market is fairly active considering the period of the year, although inquiries at present are rather light. A slight degree of hesitation in general trade still prevails in the West, and buying for the future is being done on only a narrow scale. The recent improvement in the wool industry has been of decided benefit to trade in New England, and the prospects for the coming year in that section of the country are regarded as unusually good. The tone throughout the country, with the exception of that in the West, as above, is generally optimistic, and with the greater part of the influences that have retarded progress this year already removed, there is no good reason why a period of good business should not be ushered in with the coming year. Business failures for the week ended Dec. 21, as reported by *Bradstreet's*, were 294, as compared with 309 in the preceding week, 271 in the corresponding week of 1910, 264 in 1909, 196 in 1908, and 294 in 1907.

THE COPPER MARKET.

INTEREST in the copper market has been very light this week both here and in Europe on account of the holiday, but prices have held rather firmly in spite of the small amount of business transacted. Quotations for electrolytic during the week have been in the neighborhood of 14¼ cents per pound for thirty days. Many dealers are expecting considerable improvement in prices and demand to appear with the first of the year. Just what form the price manipulation will assume in the next few months remains to be seen, but it is more than likely that the response of consumers will continue to be governed by their understanding of the relations between supply and demand in the copper industry and not by any fear that substantial advances in price are forthcoming. It is more than likely that selling interests will appreciate the advantage of keeping prices in the neighborhood of 14 cents, at which price they can make a profit, rather than run the risk of decreasing demand by further advances. The outlook for the coming year in general business is very fair, and improvement in the affairs of the country will of course be felt to some extent in the copper industry. It is hoped that a plan for the rational curtailment of output will be devised in the coming year, and that the situation will be further improved by healthy increase in demand due to application of the metal to many uses and purposes in which it is not at present employed. Exports for the month, including Dec. 27, aggregate 29,001 tons. The daily call on the Metal Exchange Dec. 27 quoted copper as per the accompanying table.

Standard Copper.	Bid.	Asked.	Settling Price.
Spot	13.87½	14.00	.....
December	13.87½	14.00	13.95
January	13.95	14.10	14.02½
February	13.95	14.15	14.05
March	13.95	14.15	14.05
April	13.95	14.10	14.02½

The London market, Dec. 27, was as follows:

	Noon. £ s d	Closing. £ s d
Standard copper, spot	63 10 0	63 15 0
Standard copper, futures	64 7 6	64 12 6

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	14.00c	11.57½c
London, spot	£63 15 0	£53 7 6
London, futures	65 0 0	54 0 0
Best selected	67 15 0	57 5 0

INDUSTRIAL AND COMMERCIAL NOTES.

Active Competition by Postal Telegraph Company.—The German Cable Company and its ally, the Commercial Cable Company, have announced a 50 per cent reduction in rates, effective Jan. 1, 1912, on public and press messages between New York and Berlin and intermediate points. Messages in plain language will be accepted by the companies after that date at 12½ cents per word in place of the existing rate of 25 cents, messages being subject to a possible delay of twenty-four hours. Press messages will be taken at 6¼ cents per word in place of the present rate of 12½ cents, messages being subject to a possible delay of nineteen hours. This move is of great importance, being a means of improving the facilities for trade between Germany and the United States, and the announcement has been received in Germany with considerable enthusiasm. In addition to this feature, the reduction is another step in the aggressive competition which the Postal Telegraph Company is carrying on against the American Telephone & Telegraph Company and allied interests. The Postal has by the new schedule with Germany met the move for public favor and increased profits made by the Western Union a few weeks ago when the American Telephone & Telegraph interest announced its deferred-message schedule to Great Britain. The Western Union cannot duplicate the Postal's move, as it has no German connections. The rivalry between the Postal Telegraph Company and the American Telephone & Telegraph Company in the telegraph and cable field has extended to the telephone field, and the appointment of Minor H. Davis as superintendent of its telephone service, mentioned in these columns last week, was the first move of the Postal in open competition in this line. The second was the announcement on the Pacific Coast last week of a new rate of 25 cents for ten-minute connection between San Francisco and Sacramento, a distance of 68 miles, as against the existing rate of 40 cents asked by the Bell interests. Proportionate reductions in tolls between the prominent cities in California, Oregon, Washington, Nevada and Utah will be made by the Postal interests, it is believed, as soon as arrangements and schedules can be perfected. Competition by the Postal in the telephone field was forecast some time ago when the company began the stringing of copper wire sufficiently heavy for telephone service on its new lines in the West. The latest move by the Western Union company was its notice that it has abolished charges for delivery of messages within the corporate limits of a municipality.

Allied Machinery Company of America Establishing More Agencies.—Captain Godfrey L. Carden, general manager of the Allied Machinery Company of America, which was organized last June to sell American machinery abroad and whose home office, under the direction of C. N. Thorn, is at 55 Wall Street, New York City, as previously mentioned in these columns, is now in Brussels perfecting details for the establishment of agencies, and will proceed soon on an extended trip throughout Europe with a view to locating branches in the more important of the foreign cities. He will locate agencies in Austria-Hungary, Turkey, the Balkan States, Russia, Sweden, Denmark, Norway, Roumania and England, and will return to Paris in the course of the next five months, after which he will return to New York for a conference with the home office. Agencies have been established in Paris, Brussels, Vienna and Milan. Considerable opposition has been met with in Germany, but the company is progressing rapidly in its field and is receiving a very gratifying proportion of orders for machinery for foreign use.

Ohio Brass Company Selling Agencies.—On Jan. 1 the agency agreement for the sale of "O-B" overhead materials, rail bonds and car equipment specialties, which has been in force between the Ohio Brass Company, of Mansfield, Ohio, and the Pierson-Roeding Company, of San Francisco, for a number of years, will terminate and will not be renewed, as it was mutually agreed that separate agency agreements for "O-B hi-tension" insulators and "O-B" electric railway equipment would eventually prove unsatisfactory, and that the interests of all concerned would be better served by a single agency for the entire Ohio Brass line. On and after Jan. 1, 1912, the Holabird-Reynolds Company, of San Francisco, which for some time past has been acting as exclusive agent for "O-B hi-tension" insulators only, will become the exclusive agent for the Ohio Brass Company for the sale of its entire line in the State of California. The Holabird-Reynolds Company will carry an adequate stock of railway materials and insulators at San Francisco, and business in Los Angeles and the southern part of the State will be handled by H. C. McCutchan, of its Los Angeles office, under the personal direction of R. D. Holabird. The business in the States of Washington, Oregon and Idaho and in British Columbia will be in charge of the Ohio Brass Company's own personal representative, F. V. Cook, who will make his headquarters in Seattle, at the office of the Holabird Electric Company. An intimate and friendly business connection between that company and the Ohio Brass Company will be maintained because of its California agency for "O-B" materials. Arrangements are being made to carry an emergency stock for quick delivery in Seattle.

Boston Edison Business Growing.—A substantial increase in the sale of new energy-consuming appliances has been enjoyed this fall by the Edison Electric Illuminating Company of Boston. The general sales of appliances for September and November were about 50 per cent in excess of last year, and for October almost 100 per cent. A large holiday business has been handled, special effort having been made to encourage the purchase of goods previous to Christmas for delivery on that or the preceding day through an appropriate address card. The first year's work in developing the Boston 1912 electric show has just ended, and the management is much gratified with the results obtained. The advance advertising has stimulated the interest of all electrical manufacturers in this country as well as that of many large producers of general commodities. More than ordinary interest has been aroused by the publicity work carried on in foreign journals. Permanent headquarters have been established at the Edison Building, 39 Boylston Street, Boston. At the end of six months' operation the company's public electric garage at 476 Atlantic Avenue, Boston, which is being operated by the sales department, is in a very prosperous condition. About sixteen electric vehicles are being constantly cared for, and the financial results are satisfactory, considering the short time the garage has been open. The efficiency of many other public garages in the Boston district has been increased as a result of the work done.

News and Trade Papers in Foreign Countries.—In order to furnish those engaged in or desirous of entering the foreign field with a general idea of the cost of newspaper advertising abroad and the papers it might be advisable to use, the Bureau of Manufactures, of the Department of Commerce and Labor, is publishing in *Daily Consular and Trade Reports* a series of reports by American consular officers on foreign news and trade papers. The reports embrace such points as location and class of paper, district covered, circulation, subscription price and advertising rates. The list for England, which included the papers in fifteen districts, appeared in *Daily Consular and Trade Reports* for Nov. 27. Lists for South American countries are in course of preparation and will be published shortly.

Electrically Operated Fender for Panama Canal Locks.—A contract for forty-eight electrically operated machines for lifting and lowering the fender chains in the locks of the Panama Canal has been awarded to the United Engineering & Foundry Company for $428,005, the lowest of ten bids received. The first, or sample, machine is to be delivered within 120 days from the date of award, and if it proves satisfactory the full award of forty-seven more machines will then be made.

The Diesel Engine.—There is a rumor that one of the large electrical manufacturing companies will take over the American rights for the manufacture of the Diesel engine, in which case sizes as large as 5000 hp. will be made.

Financial.

The Week in Wall Street.

FINANCIAL markets have moved very listlessly during the year-end period and few developments of importance have taken place. Price changes have been fractional in the majority of cases and the volume of transactions has been very narrow. The trading in the main has been professional, and few of the traders have cared to make any new commitments before the first of the year. There has been a conspicuous absence of events such as usually influence the stock market, and the only development meriting attention was announcement of extension of the time for filing answers in the government suit against the Steel Corporation from Jan. 1 to Feb. 1. Prices were nearly stationary in Wednesday's market until the closing hour. The fact that no transactions took place in the majority of usually active stocks in the first four hours of Wednesday indicates the degree of stagnation that has prevailed during the week. In the absence of other topics on Wednesday, the lockout of some 150,000 operatives of the Manchester (England) cotton mills attracted some attention in the local cotton market, but had little effect upon prices. Money market conditions are slightly easier than is generally the case at this time of the year, and rates Dec. 27 were: Call, 3½@3¾ per cent; ninety days, 3¾@4 per cent. Political affairs are beginning to attract greater interest in the financial district than has been the case in the past few weeks, and the efforts of the Republican party leaders in Congress to draw up a satisfactory bill revising the wool schedule are being closely followed. Foreign markets have been very quiet this week on account of Christmas holidays, and Wednesday's trading was without noteworthy feature. The quotations in the tables are those in the New York market Dec. 27.

NEW YORK.

	Dec. 20.	Dec. 27.	Shares Sold.		Dec. 20.	Dec. 27.	Shares Sold.
All. Ch.....	1½*	1⅜*	950	Int. Met., pf.	48¾	48	5,350
All. Ch., pf..	8	8	600	Mackay, Cos.	82*	80	800
Amal. Cop...	66¾	66½	92,500	Mackay C.,pf.	72*	69	100
Am. D. T....	33⅛*	33⅛*	——	Man. Elev...	134	135¼*	200
Am. Loco....	37	36½*	1,600	Met. St. Ry.	15*	15*	——
Am. Loco.,pf.	104*	105	——	N.Y.&N.J.Tel.	139½*	139½*	——
Am. Tel. & C.	78*	78*	——	Steel, com...	68⅝	68	393,900
Am. T. & T..	139⅞	139⅞	4,123	Steel, pfd....	111⅜	111⅛	6,180
B. R. T.....	77¼	76¾	1,240	W. U. T....	78¾	79	1,700
Gen. Elec....	155	154	2,300	W't'h, assentg	68¾	66½	8,000
Int. Met.....	15⅜	15¼	3,120	West'h, pfd..	117½	117½	200

PHILADELPHIA.

	Dec. 20.	Dec. 27.		Dec. 20.	Dec. 27.
Am. Rys.....	45¼	45*	Phila. R. T.....	23½	23¼
El. Co. of A.....	12⅛	12⅛*	Phila. Elec.....	16¾	16⅞
Elec. St. Bt'y.....	54⅜	53⅝*	Phila. Trac.....	84½	84½
Elec. St. Bt'y., pf...	30*	30*	Union Trac.....	51¼	51⅜

CHICAGO.

	Dec. 20.	Dec. 27.		Dec. 20.	Dec. 27.
Chi. City Ry.....	186*	186*	Com. Edison.....	135¼	135½
Chi. Elev. Rys.....	30⅜*	30⅜*	Chi. Subway.....	⅞	⅞*
Chi. Elev. Rys., pf..	92*	92*	Chi. Telephone....	†137¾	136½*
Chi. Rs., Ser. 1....	99	99¼*	Nat'l Car.....	103*	103*
Chi. Rs., Ser. 2.....	37½	37	Nat'l Car, pfd.....	118*	119*

BOSTON.

	Dec. 20.	Dec. 27.		Dec. 20.	Dec. 27.
Am. T. & T.....	140	140	Mex. Tel.....	3¼*	3
Cum. Tel.....	156½	156*	Mex. Tel., pf.....	6½*	6½*
Edison	295	290	N. E. Tel.....	157	152½
Gen. Elec.....	155	155*	W. T. & T.....	27½*	27½*
Mass. E. Ry.....	22¾	21¾	W. T. & T., pfd....	64¼*	64¼*
Mass. E. Ry., pf....	95¼	95			

*Last price quoted.
†Ex-dividend.
Shares sold for the week, Dec. 18 to Dec. 22.

Financial Notes.

Federal Light & Traction Company Enlarging.—As a result of steady growth of the territories served by its various properties, the Federal Light & Traction Company, 60 Broadway, is receiving very gratifying increases in revenue. The consolidated statement of earnings of the subsidiary companies for the month of November has been compiled, and the returns given in this statement show improvement over those for November, 1910, and over those for October, 1911, reported in these columns Dec. 2. Gross returns for the month were $147,543, as compared with $132,630 in November, 1910, an increase of 11.2 per cent. Operating expenses were $81,222, as compared with $70,019, an increase of 15.9 per cent, and net earnings were $66,320, as compared with $62,611 in November, 1910, a gain of 5.9 per cent. October net was 5.6 per cent larger than in October, 1910. Gross earnings in the eleven

months ended Nov. 30, 1911, were $1,201,814, as compared with $1,100,815 in the corresponding period of the previous year, a gain of 9.1 per cent. Operating expenses were $710,961, as compared with $637,701, an increase of 11.4 per cent, and net earnings were $490,852, as compared with $463,114, a gain of 5.9 per cent. Net earnings for the ten months ended Oct. 31, 1911, showed an increase of 5.4 per cent over those for the corresponding period of the previous year. The statement for the eleven months of the present year does not include the earnings of the Trinidad Electric Transmission, Railway & Gas Company, of Trinidad, Col., as this company began operations Sept. 1, 1911. Its earnings for November, however, appear in the consolidated statement for the month, as above. Progress is being made at each of the properties along the lines of improving the load factor and the installation of additional equipment. The inauguration of day service at Rawlins, Wyo., mentioned Dec. 2, has necessitated additional equipment, and a generating set and boiler are now being erected in the station. Work has been started upon the new Walsenburg power station of the Trinidad Electric Transmission Company, the cost of which will be fully $300,000. An initial equipment of 3,500 kw will be installed. The location of this company in the heart of the Colorado coal fields permits the procuring of fuel at minimum cost, thus permitting the sale of energy at favorable prices. A campaign for selling energy to the surrounding mines is now in progress. The Gray's Harbor Railway & Light Company, which serves Aberdeen, Hoquiam and Cosmopolis, Wash., has completed an extension of its railway service to a high-class residential section in its territory, and is again supplying large amounts of energy for dredging operations, which had been temporarily discontinued on account of accident to the dredging machinery. A 2000-kw generating set and several additional passenger cars have been received by the Springfield Railway & Light Company, of Springfield, Mo., and a new carhouse, built to house additional equipment, is practically finished.

Progress of Allis-Chalmers Reorganization.—The bondholders' protective committee of the Allis-Chalmers Company, of which James N. Wallace is chairman, has been engaged in a preliminary investigation into the financial condition of the company, and finds that $13,573,000 of the $15,000,000 first-mortgage 5 per cent gold bonds authorized under the mortgage of July 2, 1906, were certified by the trustees and are accounted for as follows: In the hands of the public, $11,148,000; pledged as security for loans to the company, $800,000; originally issued but later canceled, $136,000; in the treasury of the company unissued, $1,489,000. The current assets, estimated as of Dec. 31, 1911, are as follows: Receivables, $3,900,000; inventories, $5,000,000, and cash, $900,000, making a total of $9,800,000. The current liabilities against this consist of notes payable, $1,420,000, and other liabilities amounting to $1,250,000, making a total of $2,670,000, which leaves a surplus of $7,130,000. Accrued interest on the bonds due Jan. 1, 1912, is not included in the above figures. Examination of the inventories of the company by public accountants who reported under date of Dec. 20, 1911, shows that the business and net earnings of the company have been unsatisfactory and decreasing in the past few years. The works of the company at Milwaukee, West Allis, Chicago and Scranton are very valuable, and the West Allis plant, which was built in recent years, is of large capacity and of modern construction and equipment. As soon as possible after definite information as to the action of the company in regard to approaching interest is obtained the committee will submit a plan of reorganization to the bondholders, under which the necessary working capital may be procured.

Electrical Compared with Industrial and Railroad Earnings.—Henry L. Doherty & Company, of 60 Wall Street, New York City, have prepared a series of charts which show the relative increases and decreases in the gross and net earnings of steam railroads, electric railways, gas and electric companies and of industrials for each of the nine years from 1902 to 1910. To furnish data for this purpose they compiled a record of the gross and net earnings of all the steam railroads in the United States and of all the industrials listed on the New York Stock Exchange that could be traced back to 1902. They also obtained the gross and net earnings of the electric railways in most of the larger cities of the country, together with similar figures for the gas and electric-light companies, using all figures available excepting those for New York City. The voluminous data thus obtained were standardized at unity for the year 1902, and the percentage of subsequent increase or decrease was calculated with the earnings of 1902 as a basis. These derivations were plotted with the years 1902-1910 against the percentages of increased or decreased earnings as co-ordinates, with the year 1902 as unity as above. The resulting curves show most convincingly that the gas and electric industries enjoyed the most rapid increase in gross and net earnings of all of the classes plotted, and that these returns were the only ones that were practically unaffected by the panic conditions in 1907 and 1908, or the industrial depression since that time. As a matter of fact, these curves show that the gas and electric companies were the only ones during the entire period reviewed that experienced no decrease in net earnings, while the gas, electric, and street-railway companies alone showed no decrease in gross earnings. The steady increase in the earnings of the electric railways, as compared with fluctuations in those of the steam roads and industrials, is remarkably conspicuous, and due to the fact that the electric lines, in general drawing their income from passenger travel, are not affected by dullness in general business with decreased freight tonnages, as are the steam roads. The effect of curtailment along industrial lines in hard times is shown very forcibly, the income for the industrial group showing marked contraction in 1907 and 1908, these being the first lines of endeavor at which economy is directed at such times. The comparisons shown by the curves are intended to show the superiority of the securities of gas and electric properties for investment purposes, with particular bearing upon the purchase of securities for long-time holding and not for speculation.

Public Service Company of Northern Illinois.—The Public Service Company of Northern Illinois, of Chicago, by Samuel Insull, its president, has given notice that on Feb. 1, 1912, all the first-lien collateral-trust gold debentures then outstanding of the Chicago Suburban Light & Power Company, of Oak Park, Ill., dated Feb. 1, 1911, will become due and payable at par and accrued interest. These debentures will cease to draw interest after Feb. 1, 1912. The Public Service Company of Northern Illinois is successor to the Chicago Suburban Light & Power Company. It also gives notice that on Feb. 1, 1912, all the first-mortgage gold bonds then outstanding of the Evanston (Ill.) Heating Company, dated Feb. 1, 1903, will become due and payable at par and accrued interest. In this case also the Public Service Company gives the notice as successor of the company issuing the bonds.

Kentucky Utilities Company.—A company with this name has been organized to take over the electric and gas properties in Frankfort, Owensboro, Bowling Green and Hopkinsville. No definite details regarding the capitalization of the company or its plans of operation have been announced. Chicago capitalists are said to be the principals.

DIVIDENDS

Electric Storage Battery Company, preferred and common, 1 per cent, payable Jan. 2.

Kansas Gas & Electric Company, quarterly, preferred, 1¾ per cent, payable Jan. 2.

Philadelphia Company, quarterly, 1½ per cent, payable Feb. 1.

REPORTS OF EARNINGS.

AMERICAN LIGHT & TRACTION COMPANY.

Period.	Gross Earnings.	Operating Expenses.	Net Earnings.	Fixed Charges.	Net Surplus.
November, 1911.....	$401,099	$9,540	$391,559	.....	.....
November, 1910.....	392,621	9,180	386,441	.....	.....
CENTRAL & SOUTH AMERICAN TELEPHONE COMPANY.					
November, 1911.....	$115,328	$9,453	$105,875	$56,625	$49,250
November, 1910.....	90,848	2,300	88,548	49,963	38,584
CITIES SERVICE COMPANY.					
Qtr., Dec., 1911.....	$447,500	$155,000	$294,250	$143,565	$150,685
Qtr., Dec., 1910.....	435,500	165,000	271,750	143,565	128,185
*MEXICAN TELEGRAPH COMPANY.					
Qtr., Dec., 1911.....	$210,000	$42,000	$198,498	$11,500	$186,998
Qtr., Dec., 1910.....	205,000	37,500	192,000	9,500	182,500
MONTREAL STREET RAILWAY COMPANY.					
November, 1911.....	$420,476	$260,576	$159,900	$35,318	$124,582
November, 1910.....	366,098	227,442	128,656	32,013	106,643
NORTHERN OHIO TRACTION & LIGHT COMPANY.					
November, 1911.....	$214,562	$125,204	$89,359	$43,730	$45,629
November, 1910.....	189,705	110,718	78,987	43,336	35,620
TWIN CITY RAPID TRANSIT COMPANY.					
November, 1911.....	$633,968	$317,628	$316,340	$148,079	$168,261
November, 1910.....	619,149	319,732	299,417	137,912	161,505

*Partly estimated.

General News

Construction News.

CORDOVA, ALA.—The Cordova Light & Power Company, recently incorporated, has applied for a franchise to supply electricity in Cordova. Machinery for the plant has already been purchased. J. M. Miller, G. S. Elliott and E. T. Hendon are interested in the company.

HEFLIN, ALA.—It is reported that W. O. Grant contemplates the installation of an electric-light plant in Heflin.

DOUGLAS, ARIZ.—The Douglas Improvement, which operates the electric-light and power plant, the Douglas Electric Railway, the International Land Company and minor properties have been consolidated under the name of the Douglas Investment Company with a capital stock of $1,500,000. The new company proposes to increase the output of the electric plant and extend its railway system to the Sulphur Springs Valley district. James S. Douglas and W. H. Brophy are at the head of the company.

PHOENIX, ARIZ.—The Pacific Gas & Electric Company has submitted a proposition to the City Council to furnish electrical energy for street lighting for a period of two and one-half years at the rate of 6 cents per kw-hour, to be registered by meter located in the company's central station. Before the expiration of the company's contract some months ago it offered to furnish the service for a period of five years at 5 cents per kw-hour, which was rejected by the Council. The service has been furnished from month to month since.

OSCEOLA, ARK.—The Light Commission has made arrangements with Abner Driver, owner of the local electric-light plant, by which the city will take over the plant on Jan. 1, the valuation to be fixed by three appraisers. The commission will build a new power plant adjoining the railroad and install new equipment. The old plant is to be used for auxiliary purposes only.

DOWNIEVILLE, CAL.—The managers of the Brown Bear mine are reported to be contemplating the installation of an electric-power plant at the mine. J. G. Jackson is interested in the property.

ELK GROVE, CAL.—The Western States Gas & Electric Company, of Stockton, Cal., has been awarded a contract for the installation of an electric-light system at Elk Grove for a period of five years. The company is to furnish the service at a rate of 8 cents per kw-hour.

HAWTHORNE, CAL.—A special election will soon be called in Hawthorne to vote on the proposition to petition the Board of County Supervisors of Los Angeles County to install 100 new arc lamps. The Southern California Edison Company has just completed the installation of seventy-five lamps.

HUNTINGTON PARK, CAL.—At an election held recently the proposition to issue bonds to the amount of $110,000, the proceeds to be used for the construction of an electric-light plant and water-works system, was defeated. E. R. Allen is city clerk.

LOS ANGELES, CAL.—Bids will be received by the Board of County Supervisors, Court House, Los Angeles, Cal., until Jan. 15, 1912, for furnishing and installing two water-tube boilers, a vacuum cleaning plant and a heating and ventilating plant in the county hospital. H. J. Lelande is clerk of the board.

MIDWAY, CAL.—The San Joaquin Light & Power Company, of Fresno, Cal., has entered into a contract with the Standard Oil Company for the extension of its transmission lines to the oil company's seven leases in this district.

PASADENA, CAL.—The contract for the electrical work in the new Polytechnic High School has been awarded to the Newberry-Bendheim Electric Company, Stimson Building, Los Angeles, at a cost of $20,569. C. E. Cook Electric Company, 745 South Spring Street, Los Angeles, Cal., secured the contract for an electric program clock, at $3,587.

PORTERVILLE, CAL.—The City Council has notified the Tulare County Power Company, of Lindsay, which has applied for a fifty-year franchise to supply electricity in Porterville, that its application must be for a period of twenty-five years and that it must agree to install an underground-conduit system throughout the city.

SAN FRANCISCO, CAL.—It is reported that the Pacific Gas & Electric Company has acquired the entire properties of the Mutual Electric Company and has taken over its contract with the Board of State Harbor Commissioners.

GILCREST, COL.—The Commercial Club is reported to be considering the question of establishing an electric-power plant in Gilcrest.

KERSEY, COL.—It is reported that application has been made to the Council for a franchise to install an electric-light plant in Kersey.

PUEBLO, COL.—The contract for furnishing and installing lighting fixtures for the Pueblo County court house has been awarded by the Board of County Commissioners to the Morvean Company, of Cleveland, Ohio, for $20,000.

WATERBURY, CONN.—The Board of Aldermen has appointed a committee to make investigations in connection with the installation of a municipal electric-light plant in Waterbury. An appropriation of $5,000 has been made for use of the committee.

DELMAR, DEL.—The Town Council has renewed the street-lighting contract with the Sussex Light & Power Company for a period of five years. The price for street lamps has been increased $2 each per year, with the understanding that the company is to install a new lighting system, which will improve the service.

TAKOMA PARK, D. C.—Estimates for the construction and equipment of a municipal electric-light plant in Takoma Park have been submitted to the Town Council by H. G. Fetherling, of Philadelphia, Pa., and C. R. McGahey, of Baltimore, Md. The cost of the entire work is estimated at about $12,000.

ST. AUGUSTINE, FLA.—The plant and holdings of the St. Johns Light & Power Company have been purchased by W. D. Barnett, of Jacksonville, Fla. It is said that there will not be any change in the management of the company, but extensive improvements will be made to the plant and service.

ATLANTA, GA.—The State Railroad Commission has authorized the Georgia Railway & Power Company to issue $17,000,000 in capital stock and bonds to the amount of $30,000,000. The company asked for authority to issue $27,000,000 in stock and $30,000,000 in bonds. In addition to cutting the application for stock by $10,000,000 provision is made that only $12,400,000 of the bonds can be issued immediately and the remainder not until the company has applied to the commission again.

DOUGLAS, GA.—Bonds to the amount of $15,000 are reported to have been voted, the proceeds to be used for the installation of an electric-light plant and water-works system in Douglas.

MACON, GA.—The City Council has authorized the Mayor to sign the contract with the Macon Railway & Light Company for lighting the streets of the city for a period of five years to take effect from Jan. 1, 1912. Under the new contract the company agrees to furnish electricity for 7½-amp series arc lamps at $60 each per year; 4-amp magnetite arc lamps at $60 per lamp per year; 50-cp series incandescent lamps at $24 each per year; "white way" five-lamp standards, $24 per year each, these posts to be equipped with five 40-watt Mazda lamps, to burn all night and every night; for five-lamp standards carrying five 40-watt Mazda lamps, burning six hours, $13 each per year. The standards are to be installed by the city, merchants or property holders, ready for the lamps. In consideration of the low rate the city of Macon agrees to have installed during the next year ninety additional arc lamps, making a total of 400 street arc lamps, not including the ornamental lamps. The company also agrees to supply electricity for lighting for the city buildings at 5 cents per kw-hour and for commercial lighting at 12 cents per kw-hour, with discounts ranging from 10 to 60 per cent, according to consumption, and for motors at 10 cents per kw-hour, with discount ranging from 10 to 60 per cent according to consumption and prompt payment. The Macon Railway & Light Company agrees to maintain lamps, wires and poles used in connection with the street-lighting system, including the maintenance of the lamps, globes, posts and conduits in connection with the "white way," which is not the property of the company. The company also agrees to use the new magnetite-arc lamps in all future extensions of the street-lighting system.

BOISE, IDAHO.—Plans are being considered by the Idaho-Oregon Interurban Company, which recently acquired the Boise Valley Electric Railway, for the construction of a railway in South Boise and also from Nampa to Caldwell.

TWIN FALLS, IDAHO.—Plans are being considered by the City Council and the County Supervisors for the installation of a cluster street-lighting system on Shoshone Street. Lamp standards carrying three or five lamp clusters are being considered.

CABERY, ILL.—The street-lighting committee of the Village Board and a committee from Kempton are negotiating with the Chatsworth Electric Company, of Chatsworth, Ill., as to the feasibility of erecting a transmission line from the electric plant of the company in Chatsworth to supply electricity for lamps and motors in Cullom, Kempton and Cabery.

CARBON CLIFF, ILL.—The Village Board of Carbon Cliff has appointed a committee to make investigations in regard to the installation of an electric-light plant. It is proposed to establish a municipal plant. A boiler and engine is available at any time, and all that would be necessary to equip the plant would be the purchase of a generator, at a cost of about $800.

CHAMPAIGN, ILL.—Bonds to the amount of $35,000 have been voted to install an electric street-lighting system in Champaign. Under the present plan it is proposed to purchase electrical energy of the Urbana & Champaign Railway, Gas & Electric Company to operate the system.

EAST ST. LOUIS, ILL.—The City Council has granted the East St. Louis Light & Power Company permission to extend its system to Edgemont, the eastern limits of the city, for the purpose of extend-

ing its lighting system in that suburb. Additional street lamps will be installed.

EDINBURG, ILL.—The local electric-light plant, owned by J. R. Harrington, is reported to have been purchased by F. Wahl, of St. Louis, Mo.

JACKSONVILLE, ILL.—The Jacksonville Railway & Light Company has submitted a proposition to the Village Board of South Jacksonville offering to furnish electricity for lighting the village. The street-lighting contract will include fifteen incandescent lamps of 32 cp.

LA SALLE, ILL.—The La Salle Commercial Association, which a year or two ago collected $5,900 to be used toward the improvement of the Fifth Street road, has voted to have the money turned into a fund to pay for the new lighting system for the city.

MANHATTAN, ILL.—Plans are being considered by the Commercial Club for the installation of fifteen ornamental lamp standards carrying two 60-cp lamps for the business district of the city.

NORTH CHILLICOTHE, ILL.—The village of North Chillicothe has awarded a contract to the Public Service Company of Northern Illinois for lighting the streets of the village for a period of ten years. The contract calls for the installation of sixteen lamp standards carrying four tungsten lamps and eight additional 80-cp lamps.

ST. AUGUSTINE, ILL.—Arrangements have been made whereby the Abingdon Electric Light & Power Company will extend its transmission line to St. Augustine to supply electricity for lighting the city.

ST. DAVID, ILL.—It is reported that negotiations are under way between the Village Board and the Big Creek Mining Company with a view of the latter supplying electricity for lighting the streets of the village. It is understood that it is proposed to erect a transmission line from Canton to St. David.

STEWARDSON, ILL.—The Village Board has granted a twenty-year franchise to Frank Williams to construct and operate an electric-light plant in Stewardson to supply electricity for lighting the streets of the village and for commercial lighting. The board has awarded a contract for street-lighting under which the company is to furnish thirty lamps at $25 each per year. A twenty-four-hour service will be established. The plant will be driven by a 50-hp oil engine.

VIENNA, ILL.—The City Council has decided to call a special election on Jan. 15, 1912, to vote on the proposition of using electricity or gas for lighting the city, and to issue bonds for the construction of a municipal lighting plant.

WATSEKA, ILL.—A new incorporation is being organized to take over the plants and lighting systems at Watseka, which includes Milford, Gilman and Onarga; also at Chatsworth, which includes Piper City, and at Fairbury, which also operates in Forrest. It is proposed to supply electricity from a central power plant. It is proposed to enlarge the plant in Watseka and rebuild the plant at Fairbury. The new company, it is said, will be known as the Central Illinois Utilities Company or the Central Illinois Electric Company, and will be capitalized at $325,000. The charter will give the company the privilege of supplying electricity, gas, operating ice and cold-storage plants, etc.

ANDERSON, IND.—Plans have practically been completed for the installation of a new street-lighting system in the business district of the city. The plans call for erection of 250 lamp standards.

COATESVILLE, IND.—At an election held recently the proposition to install an electric-light and power system in Coatesville was carried.

CUTLER, IND.—The Cutler Co-operative Telephone Company has increased its capital stock by $6,000, the proceeds to be used for extensions and improvements to its plant. George W. Shanklin is president.

FAIRMONT, IND.—The local electric-light plant, which was recently taken over by the American Gas & Electric Company, of New York, N. Y., will be operated in connection with the Marion (Ind.) plant. It is proposed to transmit energy from the power plant in Marion to Fairmount over high-tension lines. The present plant and distributing system will be discarded when the new system is completed.

GREENFIELD, IND.—The Citizens' Electric Company, recently organized, it is said, will submit a bid for the contract to furnish electricity to light the city. If successful, the company will build and equip a new plant. J. J. Pratt is president of the company and Elam Leary is secretary.

JEFFERSONVILLE, IND.—The United Gas & Electric Company is planning to extend its transmission lines to Claysburg to supply electricity in that town. It is said that the Town Board has decided to install street lamps. The transmission line will also be extended along the gravel road to New Albany.

MARION, IND.—Application has been made to the Board of Public Works by David Blumenthal, representing the Marion Telephone Company, for a franchise to construct and operate an automatic telephone system in Marion. The company has received permission from the Commissioners of Grant County to erect telephone lines in the public highways.

ORESTES, IND.—The Orestes Telephone Company has been granted a twenty-five-year franchise in the town of Orestes. The company, which operates a large number of rural telephones in the county west and northwest of the town, will begin at once to extend its service.

SOUTH BEND, IND.—The capital stock of the Indiana & Michigan Electric Company has been increased from $1,915,500 to $2,298,600. The proceeds will be used to make improvements to the plants of the company in South Bend and Elkhart. Charles A. Chapin is president of the company.

BOUTON, IA.—At an election held recently the proposition to build and maintain an electric-light plant in Bouton is reported to have been carried. Contracts for the proposed plant, it is said, will soon be let.

CARLSBAD, IA.—W. B. Kroeger, of San Antonio, Tex., is reported to have secured the contract to install an electric-light plant in Carlsbad, to cost $14,650.

CEDAR RAPIDS, IA.—The Cedar Rapids & Iowa City Electric Light & Power Company, which owns the local electric-light plant and also operates the interurban railway to Iowa City, is reported to be contemplating the construction of an interurban railway between Cedar Rapids and Mount Vernon. The company has asked for an extension of its franchise for operating an electric-light plant in Cedar Rapids, as the present franchise has but four years to run.

CORYDON, IA.—Bids will be received by the city of Corydon until Jan. 9, 1912, for improvements to the municipal electric-light plant. Alternate bids will be received on oil engine and steam propositions. J. J. C. Bower is town clerk. The Iowa Engineering Company, of Clinton, Ia., has charge of the engineering work.

DALLAS, IA.—The Rock Island Railroad Company has commenced work on the construction of a large power plant in Dallas, which is on the new Rock Island line from Carlisle to Allertown, and the center of the large new coal fields which the new line will enter. It is said that the plant will supply electricity to operate the interurban freight and passenger trains over certain of the Rock Island lines radiating from Des Moines.

FARLEY, IA.—It is reported that work has been resumed on the construction of the local electric-light plant. Paul H. Kingsley is said to be interested in the project.

IOWA FALLS, IA.—The Peterson Electric Light & Heating Company, of Iowa Falls, is contemplating extending its transmission from Alden to Dows for the purpose of supplying electricity for lamps and motors in that town.

JEWELL, IA.—An election has been called to be held on Jan. 29 to vote on the proposition to issue bonds to the amount of $12,000, the proceeds to be used to install a municipal electric-light plant. M. J. Severson is city clerk.

MENLO, IA.—The proposition to grant a twenty-year franchise to G. F. Buckley to supply electricity for lamps in Menlo will be submitted to a vote of the people. Mr. Buckley has installed a dynamo to supply electricity to light his large implement store and proposes to furnish electrical service in the town.

MORNING SUN, IA.—P. A. Yohe, connected with the local telephone company, is contemplating the establishment of an electric-light plant in Morning Sun. He has submitted a proposition asking for a twenty-year franchise and offers to supply electricity for lamps at 15 cents per kw-hour.

OAKLAND, IA.—It is reported that the electric-light plant will be rebuilt.

REMSEN, IA.—Petitions are being circulated for a special election to be held to vote on the proposition to establish an electric-light plant in Remsen. M. R. Faber, of Remsen, is interested in the project.

ROLAND, IA.—It is reported that arrangements have been made whereby electricity for lighting the town of Roland will be received from the municipal electric-light plant at Story.

SHENANDOAH, IA.—The Artificial Ice, Power, Heat & Light Company is reported to have submitted a proposition to the Council offering a contract involving a new electric street-lighting system.

ABILENE, KAN.—It is reported that a special election will soon be held to vote on the proposition of extending the franchise of the Riverside Light & Power Company. If the ordinance fails, it is expected that a special election will soon be called to submit the proposition to establish a municipal electric-light plant to a vote.

LANSING, KAN.—The Leavenworth Light, Heat & Power Company is contemplating extending its transmission line to Lansing to supply electrical service in that town.

TOWANDA, KAN.—Contracts have been awarded by Ford Bolton to the United Electric Company, of Wichita, Kan., for equipment for a complete electric-light plant to be installed in Towanda.

WICHITA, KAN.—At an election held Dec. 12 the proposition to establish a municipal electric-light plant was defeated. Bonds to the amount of $1,000,000 were voted to build a municipal water-works system.

DONALDSONVILLE, LA.—The City Council, it is reported, is considering improvements to the municipal electric-light plant, including the installation of new engines, to cost approximately $30,000.

THIBODAUX, LA.—The Town Council has decided to reduce the price for electricity for lamps from 15 cents per kw-hour to 10 cents per kw-hour, the rate to take effect from Nov. 1, 1911.

BIDDEFORD, MAINE.—The Clark Power Company, recently incorporated, proposes to generate and distribute electricity for lamps, heat and motors in the towns of Buxton, Hollis and Dayton. The company is capitalized at $10,000 and the officers are: Cecil F. Clark, of Hollis, president; Lucien F. Clark, of Dayton, treasurer, and George L. Emery, of Saco, clerk.

CALAIS, MAINE.—The Calais Street Railway Company has purchased the water-power privilege in Milltown, Maine, owned by the James Murchie & Sons Company. The street-railway company, it is said, intends to erect a modern power plant on the site to supply energy to operate the railway and for other purposes. The steam-power plant at Ferry Point will be maintained as an auxiliary when the new plant is completed.

WILTON, MAINE.—The Wilton Electric Light, Gas & Power Company has filed an amendment to its charter, changing its name to the Wilton Light Company and increasing its capital stock from $10,000 to $50,000.

LEOMINSTER, MASS.—George B. Spring, superintendent of the Leominster Electric Light & Power Company, has submitted a proposition to the town officials offering to erect and maintain a large electric sign in a prominent part of the town provided the town will furnish a site.

NORTH EASTON, MASS.—Preparations are being made by the Edison Electric Illuminating Company of Brockton for the erection of an electric-light system in North Easton, for which the company was granted a franchise some time ago.

SOMERVILLE, MASS.—Among the recommendations submitted to the Board of Aldermen by the aldermanic finance committee is the establishment of a municipal lighting plant to light the city hall, public library and high schools.

GRAND RAPIDS, MICH.—Mayor Campbell has appointed a committee to look into the question of installing a municipal electric-light plant. At present the Grand Rapids-Muskegon Power Company supplies the city with electric service.

JACKSON, MICH.—The State Railroad Commission has granted the petition of the Commonwealth Power Company to issue bonds to the amount of $1,860,000, the proceeds to be used for extensions and improvements to its properties in Grand Rapids, Muskegon, Owosso, Jackson and several other cities.

SPARTA, MICH.—The plant of the Sparta Milling Company, including an electric-light plant, grain elevator and coal yard, was destroyed by fire recently, entailing a loss of about $200,000.

GLENCOE, MINN.—The contract for furnishing the city with a 36-kva generator was awarded to the Electric Machinery Company, of Minneapolis, Minn. The Power Equipment Company, of Minneapolis, Minn., secured the contract for a Foos oil engine to operate the plant.

MANKATO, MINN.—The Consumers' Power Company contemplates extending its system to towns adjacent to Mankato. An electric transmission line may be erected through Vernon Center, Amboy, Winnebago and Blue Earth, one through Kasota and St. Peters, another to Lake Crystal, one to Faribault through Janesville, Waseca, Waterville and Eagle Lake, Madison Lake and Elysian. The company has already secured franchises in some of these places. Energy for operating the system will be supplied from the power plant at Rapidan dam.

SLEEPY EYE, MINN.—The contract for furnishing a 75-kw, 2300-volt, alternating-current generator for the municipal electric plant was awarded to the Electric Machinery Company, of Minneapolis, Minn.

WAYZATA, MINN.—It is reported that bonds have been voted for the installation of a municipal electric-light plant and water-works system. The cost of the electric plant is estimated at $15,000.

WOOD LAKE, MINN.—The installation of a municipal electric-light plant in Wood Lake is reported to be under consideration by the City Council.

LINCOLN, MO.—It is reported that preliminary steps have been taken by W. C. Cain for the installation of an electric-light plant in Lincoln It is proposed to erect a plant and supply electricity for lighting the streets of the city and also for commercial and residential lighting.

SKIDMORE, MO.—The Maryville Light & Power Company, of Maryville, Mo., has submitted a proposition to supply electricity in Skidmore. The cost of the proposed plan is estimated at about $8,000 and would include the erection of a transmission line 14 miles long.

BUTTE, MONT.—Plans are being considered by the North Butte Mining Company for the installation of electrically operated ore cars throughout its properties.

STANTON, NEB.—Arrangements have been made for extensions and improvements to the municipal electric-light and water plant, including the erection of a boiler room, 30 ft. x 40 ft., and the installation of one 125-hp boiler, one 100-hp steam engine and an additional generator, for which bids will be received until Jan. 8, 1912. C. A. Hickman, of Sioux City, Ia., consulting engineer, has charge of the work.

FALLON, NEV.—The Secretary of the Interior at Washington, D. C., has authorized the Reclamation Service to purchase copper wire for use in the erection of the transmission line from Lahontan to Fallon, Nev., the cost not to exceed $6,000. The proposed line will transmit electricity developed at the dam to Fallon to be used for municipal and other purposes.

TUSCARORA, NEV.—The Tuscarora Mines Company is planning to enlarge its electric-power plant. H. S. Haskins is general manager of the company.

WINNEMUCCA, NEV.—The contract for the installation of machinery at the new power plant of the Winnemucca Water & Light Company has been awarded to the C. C. Moore Company, of San Francisco, Cal.

WONDER, NEV.—The managers of the Jack Pot mine will soon begin work on the erection of a transmission line, 1½ miles in length, to its properties. E. S. Cunningham is superintendent.

ROSWELL, N. M.—The Mountain States Telephone & Telegraph Company has submitted a proposition to the City Council offering to install a fire alarm system in the city of Roswell and to maintain the same hereafter, provided the city will pay for the boxes and $300 per year for maintenance for same. The cables and wires of the Mountain States Telephone & Telegraph Company are to be put in underground conduits in the business district of the city.

BROOKLYN, N. Y.—The contract for furnishing and installing an air compressor at Williamsburg Bridge, borough of Brooklyn, has been awarded to the Blaisdell Machinery Company, of Bradford, Pa., at $6,350.

LESTERSHIRE, N. Y.—Plans are being prepared for the erection of an electric-power plant to supply electricity to operate the shoe shops owned by Endicott, Johnson & Company in Lestershire. It is expected that the service will eventually be extended to Endicott.

OSWEGO, N. Y.—The People's Gas & Electric Company is planning to extend its transmission lines to supply electricity in the suburbs. It is proposed to extend its system to the Beach and connect with the main lines at Fruit Valley.

SYRACUSE, N. Y.—Among the recommendations to the State Legislature for appropriations for the Syracuse State Institution for Feeble-Minded Children are: For the reconstruction of the local telephone system, $1,500; rewiring electric system, $3,927; electric-light plant, $8,000, etc.

WATERTOWN, N. Y.—The Watertown Light & Power Company has commenced work on the erection of a transmission line from the terminus of the present line at Brownville to the plant of the Parchment Paper Company at Dexter. The Watertown company is preparing to supply the Parchment company with electricity to operate its plant. The contract calls for 400 hp. The Watertown Light & Power Company is said to be negotiating with other companies in Dexter with a view of supplying energy to operate other industries in that town.

SHELBY, N. C.—At a special election held Dec. 5 the proposition to issue bonds to the amount of $13,000 to take over the plant and holdings of the Shelby Electric Light Company was carried. The city will take over the plant on May 1, 1912, provided the bonds are disposed of by that time.

KENMARE, N. D.—The Kenmare Light & Power Company is contemplating extensive improvements to its plant and service both in the city and at the mines.

MICHIGAN, N. D.—The question of installing an electric-light plant in Michigan is reported to be under consideration by the City Council.

REYNOLDS, N. D.—The City Council is reported to be considering the installation of an electric-light plant.

CINCINNATI, OHIO.—The City Council has adopted a resolution directing the Union Gas & Electric Company to supply electricity for lighting in Mount Washington, Carthage and Madisonville in accordance with an annexation agreement.

COLDWATER, OHIO.—William Jasperson, of St. Mary's, Ohio, has been granted a fifteen-year franchise to construct and operate an electric-light plant in Coldwater and a ten-year contract for lighting the streets of the town. It is said that a company has been formed to operate the system.

COLUMBUS, OHIO.—Arrangements have been completed whereby the power plant at the State penitentiary will supply electricity for lighting the State House. Within a short time the plant will supply electricity for lighting the State school for the blind; eventually other State institutions will be connected with the plant. Until the present time the service has been supplied by the Columbus Railway & Light Company. Arrangements have been made with the municipal electric-light plant to supply the service in case of emergency.

DELAWARE, OHIO.—The City Council has granted the Delaware Electric Light, Heat & Power Company a renewal of its franchise for a period of ten years.

EAST LIVERPOOL, OHIO.—Plans are being considered for extensive improvements to its main power plant and substations along the railway. The output of the plants at East Liverpool and Steubenville will be doubled.

MASSILLON, OHIO.—Plans have been submitted to the City Council by Public Service Director Pietzcker for the installation of an ornamental street-lighting system in the downtown district. He recommends replacing the present arc lamps with ornamental lamp standards carrying a cluster of incandescent lamps. The cost of the proposed change is estimated at $9,017, which would provide for three standards carrying five incandescent lamps and sixty-three three-lamp standards.

SIDNEY, OHIO.—The Western Ohio Electric Railway Company has secured a ten-year franchise to supply electricity for lamps, heat and motors in Sidney. The company is furnishing street-lighting service in Beaver Dam and Rawson and is preparing to install street lamps in Lockington and Mount Cory.

ZANESVILLE, OHIO.—Preparations are being made by the Southeastern Ohio Railway, Light & Power Company for the installation of a new turbine at its power plant in Zanesville.

MUSKOGEE, OKLA.—The Missouri, Oklahoma & Gulf Railway Company, which is planning to extend its lines from Wagoner, Okla., to Kansas City, and south from Sherman, Tex., to the Gulf, will equip

the line between Wagoner and Muskogee for electrical operation, it is said. An electric railway, it is reported, will be built east from Wagoner to the Grand River, where a large amusement park will be established.

OKLAHOMA CITY, OKLA.—The City Commissioner has awarded the contract for the construction of an electrolytic sewage-disposal plant, to be erected at Ash Street and Western Avenue, to J. A. McMahan and S. P. Bennett, to cost $46,582.

ASHLAND, ORE.—A special election will soon be held to vote on the proposition submitted by the Siskiyou Electric Light & Power Company to purchase the municipal electric-light plant at a price of $105,000, the title to remain with the city until the outstanding bond issue of $100,000 is settled. The company requests a fifty-year franchise and agrees to give the present flat rate charged for electric energy. Bonds to the amount of $75,000 were originally voted for the construction of the municipal electric plant, and this has been further increased by $30,000. While the present franchise of the Siskiyou company, in the name of the Ashland Electric Power & Lighting Company, was repealed Oct. 15, an extension has been granted, inasmuch as the company has been fulfilling its contract of emergency service on peak load period at the municipal plant.

BAKER, ORE.—The Kent Ore Reduction Company has begun work on the installation of an electric-power plant to supply electricity to operate its mining properties. H. W. Kent is manager of the company.

GALICE, ORE.—Plans are being prepared by the Cougar Consolidated Mine Company, which operates the Barr placer mines, for the installation of an electric-light plant at its properties. L. H. Medford is manager of the company.

PORTLAND, ORE.—The Stark Street Improvement Association is planning the installation of an ornamental street-lighting system on Stark and Burnside Streets. It is proposed to use the cluster lamp system.

PORTLAND, ORE.—A special meeting of the Pacific Power & Light Company will be held Dec. 29 in Augusta, Maine, to vote on the proposition to increase the capital stock of the company from $7,500,000 to $12,000,000. The proceeds of the stock will be used to liquidate floating debts and provide additional working capital.

PORTLAND, ORE.—The Oregon Electric Railway Company has filed amendments to its charter with the State Department increasing its capital stock from $100,000 to $6,000,000. The company is planning the construction of an electric railway from Natron to Ontario, with branches to Agency Plains, Klamath Falls, Lake View and Goose Lake.

PANAMA.—Sealed proposals will be received at the office of the general purchasing officer, Isthmian Canal Commission, Washington, D. C., until Jan. 25 for furnishing automatic signal material for the relocation of the Panama Railroad. Blanks and general information relating to this circular (No. 669) may be obtained from the above office or the offices of the assistant purchasing agents, 24 State Street, New York, N. Y.; 614 Whitney-Central Building, New Orleans, La., and 1086 North Point Street, San Francisco, Cal. Major F. C. Boggs is general purchasing officer.

AVONMORE, PA.—Application will be made on Jan. 2, 1912, for a charter for the Avonmore Electric Company, which proposes to supply electricity for lamps and motors in the borough of Avonmore. Interests connected with the West Penn Electric Company are concerned in the project. H. L. Mitchell, U. W. Tinker and Thomas S. Henderson are the incorporators.

INDIANA, PA.—The West Penn Electric Company, it is reported, will apply for a franchise in Indiana after Jan. 1, 1912, to erect transmission lines to supply electricty for lamps and motors. If granted a franchise the company will begin work on erection of the line as soon as the right-of-way is secured.

PHILADELPHIA, PA.—The Philadelphia Electric Company submitted the only bid to supply electricity for lighting the streets of the city. The prices given are the same as under the present contract, under which the company furnishes electricity for lamps erected on poles or fixtures connected by cable installed in pipe or conduit owned by the company at 29 cents per lamp per night, and for electricity furnished for lamps erected or transferred to ornamental poles furnished by the company and attached to underground cables in the conduits owned by city at 27 cents per lamp per night. Including 936 additional are lamps, which were put into service about Sept. 1, the city's electric-lighting system will cost this year about $1,268,752. The estimate of the Electric Bureau for 1912 is $29,356 for electric lighting of the Southern Boulevard, and the 936 additional lamps installed last year will cost $1,356,478. The bureau asks for $25,000 for new lamps this year. The total number of street lamps now in use is 14,038.

READING, PA.—Preparations are being made by the Metropolitan Electric Company, of Reading, to supply electricity for lamps, heat and motors in Lebanon and vicinity from its new power plant at West Reading. The Edison plant at Lebanon will be kept intact for use in emergencies. The Metropolitan company will supply energy to operate the proposed electric railway to be built between Myerstown and Womelsdorf.

MENNO, S. D.—The Town Board recently granted a franchise to Skorepa & Schenk, of Menno, S. D., to install and operate an electric-light plant in Menno.

EMBREEVILLE, TENN.—The Nolachuckey Power Company is planning to install a power plant and cotton mill in Embreeville. The proposed work will include a dam 90 ft. in height, which will create a lake about 6 miles in length. The company proposes to supply electricity in Embreeville and all the neighboring towns. The cost of the plant is estimated at about $200,000.

COLLEGE STATION, TEX.—The contract for electric wiring of the new dormitory and the new engineering building at the Agriculture and Mechanical College has been awarded to the Barden Electric Company, of Houston, Tex. F. E. Giesecke is college architect.

DALLAS, TEX.—A committee has been appointed to investigate various systems of lamps and equipment for an ornamental street-lighting system on Main and Commerce Streets and the streets between these thoroughfares. Requests from property owners indicate that the district may be enlarged. L. Blaylock is chairman of the committee.

PECOS, TEX.—The Tri-State Telephone Company, it is expected, will begin work within ninety days on the erection of a new telephone line between Midland and Pecos and from Pecos to Carlsbad, to cost approximately $120,000. The company has recently taken over a number of independent telephone lines in this section.

WACO, TEX.—Property owners on Austin Avenue and the Young Men's Business League are reported to have decided to install an ornamental lighting system on ten blocks on that thoroughfare. It is proposed to erect ornamental lamp standards, each carrying five lamps, ten to a block.

OGDEN, UTAH.—Plans are being considered by the Ogden Rapid Transit Company for an extension of its railway to the Huntsville district, a distance of about 8 miles. The cost of the work is estimated at about $300,000. J. W. Bailey is superintendent.

SALT LAKE CITY, UTAH.—The Telluride Power Company, it is reported, will apply to the City Council for a franchise to construct and operate an electric distributing plant in Salt Lake City. The company proposes to supply electricity for manufacturing plants in both large and small quantities. A complete lighting system will be installed if sufficient patronage is guaranteed.

RUTLAND, VT.—Arrangements are being made by the Rutland Railway, Light & Power Company to extend its transmission lines to South Poultney, where it will supply electricity to the quarries. The company will also extend its service south on the Granville Road as far as Donnelly Hill and will furnish electricity in the intermediate territory.

ATTALIA, WASH.—The County Commissioners have granted the Attalia Land Company a franchise to construct an electric-light and power plant and water-works system.

BELLINGHAM, WASH.—It is reported that the large cement plant which is being erected by the Balfour-Guthrie Company in Bellingham will be equipped for electrical operation.

CAMAS, WASH.—The Northwestern Electric Company, of Portland, Ore., has been granted a franchise to supply electricity for lamps and motors in Camas. A transmission line will be erected from its proposed hydroelectric power plant on the White Salmon River to Camas, work on which has commenced.

CHEHALIS, WASH.—The Washington-Oregon Corporation is reported to have applied to the Board of County Commissioners for a franchise to supply electricity in the towns of Adna and Littell.

IRONDALE, WASH.—The Irondale Light & Power Company has made application to the Board of County Commissioners for a franchise to extend its electric transmission system to various parts of Jefferson County. The company proposes to distribute energy from the main transmission line of the Olympic Power Company. A. R. Coleman and W. L. Jenkins are interested in the company.

LONGMINE SPRINGS, WASH.—Plans are being prepared by Frederick Heath, architect, of Tacoma, Wash., for the construction of a four-story hotel to be erected at Longmine Springs, to cost $800,000. An electric-power plant, it is stated, will be installed. Longmine Springs has not a post office.

OLYMPIA, WASH.—Plans are being considered by the City Council for the installation of arches, carrying tungsten lamps, on East Fourth Street.

PATEROS, WASH.—Work is progressing rapidly on the new electric-power plant, which is located on the Methow River, about 2½ miles from Pateros. The plant when completed will supply electricity for lamps and motors in Pateros, Methow and Brewster. The company is securing contracts for furnishing energy to operate pumping plants for irrigation purposes.

SEDRO-WOOLLEY, WASH.—The Council has granted the Bellingham & Skagit Interurban Railway Company an electric-light franchise in Sedro-Woolley for a period of fifty years.

SUMNER, WASH.—Plans have been prepared for the construction of a new yeast-manufacturing plant for the Fleischman Company, of New York, N. Y., at Sumner. The proposed plant will include an electric generating plant to supply electricity for lamps and motors. Robert Embleton will have charge of construction.

WALLA WALLA, WASH.—Sealed proposals will be received by the State Board of Control, Olympia, Wash., until Jan. 3, for electrical supplies for the State Penitentiary at Walla Walla, plans and specifications for which are on file at the office of John Kow, architect, Paulsen Building, Spokane, Wash.; office of superintendent of penitentiary,

Walla Walla, Wash.; Saunders & Lawton, Alaska Building, Seattle, Wash., and Bullard & Hill, architects, Provident Building, Tacoma, Wash.

KIMBALL, W. VA.—A contract for the construction of an electric-light plant and water-works system in Kimball has been awarded to the Russell Company, of Dayton, Ohio. The cost of the work is estimated at $50,000. A fifty-year franchise is included in the transaction. I. Tobin is interested in the enterprise.

MORGANTOWN, W. VA.—The Kuhn interests, headed by J. S. & W. S. Kuhn, of Pittsburgh, Pa., it is reported, will build large dams on the Cheat River in West Virginia for power purposes, the syndicate of English capitalists having withdrawn the contest for property rights. The Cheat River project will involve an expenditure of more than $1,000,000.

RAVENSWOOD, W. VA.—The gas engine in the municipal electric-light plant was completely wrecked on Dec. 24. The engine is a 75-hp Columbus, throttling type, and has been used about two years. C. O. Nillson is superintendent.

BELOIT, WIS.—The Beloit Water, Gas & Electric Light Company has reduced the price of electricity to large consumers for manufacturing purposes. The new rate is from 4 cents to 2 cents per kw-hour.

LAKE GENEVA, WIS.—Efforts are being made by the local business men to have the Milwaukee Electric Railway & Light Company extend its electric transmission line from Burlington to Lake Geneva to supply electrical service here.

LA CROSSE, WIS.—Receivership certificates of the La Crosse Water Power Company amounting to $150,000 are reported to have been sold. Work, it is said, will soon begin on repairing the damage to the plant in Hatfield caused by the flood last October.

MADISON, WIS.—Bids will be received by Lew F. Porter, secretary of the Capitol Commission of Wisconsin, Madison, Wis., until Jan. 16, 1912, for furnishing material and labor for the electric work of the south wing of the Wisconsin State Capitol, now under construction at Madison. Plans and specifications may be examined at the office of George B. Post & Sons, architects, 347 Fifth Avenue, New York, N. Y., office of the Capitol Commission, Madison, Wis., and the Builders & Traders' Exchange, Milwaukee, Wis. Plans may also be obtained from Lew F. Porter, secretary, upon deposit of $100, which will be refunded upon return of the plans.

SHEBOYGAN, WIS.—The controlling interest in the Sheboygan Railway & Light Company, of Sheboygan, Wis., is reported to have been acquired by F. W. Roebling, of Trenton, N. J. The company is capitalized at $600,000 and operates an interurban railway, from Sheboygan to Elkhart Lake, 23 miles long, as well as the city car line and the local lighting and power plant.

DUNSMUIR, B. C., CAN.—The Canadian Collieries, Ltd., has awarded the contract for the construction of its proposed hydroelectric power plant on the Puntledge River to Grant Smith & Company, Pacific Building, Vancouver, B. C. The cost of the plant is estimated at about $500,000.

OAK BAY, B. C., CAN.—The City Council is advertising for bids for the installation of an electric street-lighting system.

VANCOUVER, B. C., CAN.—Plans are being prepared by L. E. Geary, naval architect, for the Bell-Irving Company, Ltd., of Vancouver, B. C., Can., for three cannery boats. A separate power plant will be installed on each vessel to supply electricity for lamps, searchlight and pumping.

VANCOUVER, B. C., CAN.—Contracts have not yet been placed for all of the machinery for the proposed hydroelectric plant of the Canadian Collieries, of Dunsmuir, to be erected on the Punledge River, Vancouver Island. As yet some of the details for construction of plant have not been decided upon. Grant, Smith & Company, of Vancouver, B. C., have secured the contract for construction of plant. H. K. Owens, Hoge Building, Seattle, Wash., is consulting engineer.

VICTORIA, B. C., CAN.—The Wellington Colliery Company has been granted permission by the government to construct a power and impounding dam on the Point Ledge River, near the outlet of Comax Lake.

SELKIRK, MAN., CAN.—It is reported that plans are being considered for the installation of a municipal electric-light plant in Selkirk, for which bonds to the amount of $25,000 will be issued.

HALIFAX, N. S., CAN.—Negotiations have been completed for the merger of the Halifax Electric Tramway Company and the MacLeod Pulp & Paper Mills Company. The last-named company controls the water-power on the Mersey River, where it is estimated that 25,000 hp can be developed, and the Halifax Electric Tramway Company owns water rights on the Gaspereau River capable of developing 5000 hp. The capital stock under the consolidation will be $6,000,000. The company proposes to supply electricity for lamps and motors. Sir Frederick Borden, R. A. Robert and J. W. McConnell, of Montreal, Que., Can.; B. F. Pearson, F. B. McCurdy, M. P., John R. MacLeod, of Halifax, and Frank Stanfield, of Truro, are interested in the company.

LONDON, ONT., CAN.—Plans are being considered by the Northwestern Radial Railway Company for the construction of a power plant and dam at Rock Glen, Arkona, Ont., work on which will probably begin next spring. The proposed work will involve an expenditure of about $3,000,000 and include the construction of a railway and power plant. Smith, Kerry & Chace, of Toronto, Ont., are engineers. D. A. Stewart is chairman.

PETERBORO, ONT., CAN.—Negotiations are under way between the Hydroelectric Power Commission and the Otonabee Power Company, of Peterboro, for the acquiring by the commission of the generating plant and distributing system of the company. This is another step toward the introduction of a public power service into the Trent Valley by the commission.

WATERFORD, ONT., CAN.—At an election held recently the ratepayers voted in favor of the proposition to issue bonds for the construction of an electric-light plant in Waterford.

EMARD, QUE., CAN.—The plant and holdings of the St. Paul Light & Power Company are reported to have been purchased by the Canadian Light & Power Company, of Montreal, Que. The consideration is said to be $100,000.

QUEBEC, QUE., CAN.—The City Council has awarded the contract for street lighting to the Dorchester Electric Company on condition that the net rates for electricity to private consumers are reduced from 10 cents to 7¼ cents per kw-hour. The franchise of the company, which expires this year, was extended. Plans have been prepared by the Dorchester company for the erection of its plant. The distribution system will include 20 miles of underground work and 50 miles of overhead lines. Ornamented lamp standards will be used on the principal streets, of which about 250 will be required. The Quebec Railway, Light, Heat & Power Company holds the present contract.

New Industrial Companies.

THE ELECTRICAL SUPPLY MANUFACTURING COMPANY, of Brooklyn, N. Y., has filed articles of incorporation with a capital stock of $25,000. The incorporators are: E. Pereya and T. L. Pereya, of Brooklyn, N. Y., and M. C. Worth, of New York, N. Y. The company proposes to manufacture electrical supplies.

THE ELECTRIC WIND TURBINE COMPANY, of Rochester, N. Y., has been incorporated with a capital stock of $150,000 by J. C. Childs and B. G. Tallman, of Rochester, N. Y., and M. W. Comstock, of Buffalo, N. Y. The company proposes to manufacture electrical machinery, windmills, etc.

THE ELECTROLYTIC PROCESS COMPANY, of New York, N. Y., has been incorporated with a capital stock of $600,000 for the purpose of manufacturing alloys of metals, electroplating, etc. The incorporators are: M. C. Dobson, F. P. Burrall and F. H. Richmond, of New York, N. Y.

THE INTERNATIONAL GAS ENGINE COMPANY, of Harrison, N. J., has been incorporated with a capital stock of $100,000 by E. F. Paulu, G. R. Townsend, of East Orange, N. J., and E. M. Souza, of New York, N. Y. The company proposes to manufacture engines, machines, dynamos, motors, etc.

THE JENKS LANTERN COMPANY, of Chicago, Ill., has been incorporated by Harriet B. Jenks, Lloyd C. Spencer and W. H. Chapman. The company is capitalized at $16,000 and proposes to manufacture and deal in electrical appliances.

THE LOMBARD MANUFACTURING COMPANY, of Rochester, N. Y., has been incorporated with a capital stock of $30,000 by J. C. Lombard, P. W. Hodgkinson and S. C. Ward, of Rochester, N. Y. The company proposes to manufacture engine starters, mechanical devices, etc.

THE RELIABLE MAINTENANCE COMPANY, of Chicago, Ill., has been granted a charter with a capital stock of $2,500 to manufacture and deal in electrical equipment. The incorporators are: Samuel M. Rush, George W. Clausing and L. Jost.

New Incorporations.

FRESNO, CAL.—Articles of incorporation have been filed for the Fresno & Eastern Railway Company by George A. Aldrich, of Audubon, N. J.; Fayette M. Meigs, of Oakland, and Albert B. Dodd, of San Francisco, Cal. The company is capitalized at $1,500,000, and proposes to build an electric railway from Fresno to Shaver, in the Sierra Mountains, a distance of about 78 miles.

MARYSVILLE, CAL.—The Northern Electric Railway Company has been incorporated with a capital stock of $1,500,000 for the purpose of building the Marysville-Colusa branch. The proposed railway will be 30 miles long. The incorporators are: Leon J. De Sable, George E. Springer and Herbert W. Furlong.

SAN FRANCISCO, CAL.—The Northern Power & Water Company has been chartered with a capital stock of $25,000,000 by F. T. Boland, C. F. Willard, H. F. Atkinson, A. J. Allan and A. C. Green, all of San Francisco, Cal., and S. J. Langmaid, of Berkeley, Cal.

MARION, IND.—The Marion Telephone Company has been incorporated with a capital stock of $100,000 by David Blumenthal and Jerome Herff.

Personal.

MR. A. H. VAIL has resigned as resident manager for the City Gas & Electric Company at Paris, Ill. He will be succeeded by Mr. F. W. Bowen, of Chicago.

MR. E. V. D. JOHNSON, manager of the Northern California Power Company at Redding, Cal., has moved his office to San Francisco, where the headquarters of the company are located.

MR. REGINALD B. BENGER, commercial manager of the brush department of the Morgan Crucible Company, Ltd., London, England, is at present on a short visit to the United States.

MR. H. THURSTON OWENS will lecture before the New York Section, Illuminating Engineering Society, on Jan. 11, 1912, on "Modern Practice in Street Lighting, with Especial Reference to New York City."

MR. EUGENE CREED, formerly in charge of the new-business department of the Toronto Electric Light Company, will assume the management of the advertising department of the Morris Iron Company, of New York City and Frederick, Md., after the first of the year.

MR. JAMES A. DOUGHERTY, of Easton, Pa., has been appointed commercial manager of the Bristol (Tenn.) Gas & Electric Company. Mr. Dougherty succeeded Mr. A. J. Young, who has resigned to become general manager of the Galveston (Tex.) Electric Company.

MR. HENRY FLOY, consulting engineer, of New York, has been engaged by the receiver of the Twenty-eighth and Twenty-ninth Streets Crosstown Railroad Company, Mr. J. B. Mayer, to make an appraisal of the property of that railroad in New York City for use in connection with the reorganization of the company, as well as at hearings before the Public Service Commission.

MR. E. C. FOSTER has been appointed general manager of the Manchester Traction, Light & Power Company, Manchester, N. H., succeeding Mr. J. Brodie Smith, whose resignation is referred to elsewhere in this column. Mr. Foster was formerly second vice-president of the New Orleans Railway & Light Company, New Orleans, La., and more recently has been connected in a confidential and advisory capacity with Messrs. Sanderson & Porter, of New York.

MR. GEORGE W. WILDER has severed his connection with the Edison interests at Santa Barbara, Cal. During the two and one-half years in which Mr. Wilder was connected with the company he effected the consolidation of the Edison Electric Company and the Merchants' Mutual Light & Power Company into the present Santa Barbara Gas & Electric Company, rebuilt the distribution system of the two plants and enlarged the power station of one of the companies, the other station having been dismantled. Mr. Wilder is succeeded by Mr. J. H. Fisher, of Redlands.

MR. W. E. DAVIS, vice-president in charge of sales of the Goulds Manufacturing Company, Seneca Falls, N. Y., has just started on an extensive trip in the interests of the company. He is planning to visit its representatives in Boston, New York, Philadelphia, Richmond, Pittsburgh, Wheeling, Cleveland, Warren, Cincinnati, Louisville, Chicago, St. Louis, Kansas City, Joplin, Memphis, Birmingham, Montgomery, Mobile, New Orleans, Beaumont, Houston, Galveston, San Antonio, El Paso, Phœnix, Tucson, Albuquerque, Los Angeles, San Francisco, Portland, Seattle, Tacoma, Boise, Salt Lake City, Denver, Omaha. If everything goes as planned, Mr. Davis expects to complete his trip and return to Seneca Falls early in March.

MR. J. BRODIE SMITH, vice-president and general manager of the Manchester (N. H.) Traction, Light & Power Company, has resigned with the intention of entering private engineering practice with offices at Room 2, Odd Fellows' Building, Manchester. Mr. Smith has been engaged in electrical work for about twenty-five years and has been prominent in Manchester central-station circles since the organization of the Ben Franklin Electric Light Company, which was later consolidated with the Manchester Electric Light Company. Since 1901 he has been general manager of the Manchester Traction, Light & Power Company, which controls the street-railway and central-station business of the Manchester district. Under his management the properties have developed along sound and progressive lines, including the development of several hydroelectric power plants in the Merrimac Valley and important street-railway extensions and park establishments. The earnings of the company have risen during his administration from about $70,000 to $500,000 per year. Mr. Smith will take up his new work about Feb. 1, and will be succeeded at Manchester by Mr. E. C. Foster, of New York, formerly general manager of the Boston & Northern Street Railway Company, and later president of the New Orleans Railway & Light Company.

MR. CHARLES P. MADSEN, designer of the line of electrically heated appliances made by the Pelouze Electric Heater Company, of Chicago, and one of the organizers of that company, has resigned and sold his interest in the company to engage in engineering and designing work for himself, with office and laboratory at 38 North Clinton Street, Chicago. Mr. Madsen came to Chicago in 1908 from Salt Lake City, where he had been engaged in electric-heating-appliance design and manufacture in a small way for a year previous. Before entering this field he was for two years an assistant in the physics and electrical laboratories of the Utah State School of Mines, and before that was for seven years engaged in practical electrical work of various kinds at Salt Lake City. During the latter part of his studies at the Utah State School of Mines he began the investigation of the elements of electrically heated apparatus, including the properties of alloys and high-temperature insulating materials. During the school year 1910 and 1911 he gave a course of lectures to the senior class at the Lewis Institute, Chicago, on the principles of duplicate manufacture. He also gave a special lecture on the design of electrically heated apparatus. He is the author of a table on the electrical properties of nichrome resistance metal, which is the result of extended investigation, and has made a special study of the insulating qualities of compounds and materials under high temperatures, resulting in the preparation of a number of such compounds for withstanding the high temperature which is common with the new nickel-chromium alloys now much used in electrically heated appliances. In his new work Mr. Madsen will act as designing and consulting engineer for those engaging in the manufacture of electrically heated appliances, and will undertake any special research necessary. He will also design apparatus for use in various industrial processes for the users of such processes.

Trade Publications.

BALL-BEARING GREASE.—The Hess-Bright Manufacturing Company, Philadelphia, Pa., has issued a booklet in which are outlined the requirements of a ball-bearing grease. Particular attention is directed to artificial grease made by blending mineral oils with soap formed from horse oil treated with caustic.

EDISON MAZDA LAMPS FOR STANDARD TRAIN-LIGHTING SERVICE.—Owing to the improvement in the manufacture of the tungsten lamp the delicacy of the filament has been overcome and the improved type of the G-E Edison "Mazda" lamp is now suitable for use in train lighting. These lamps are made in two voltage ranges, 25-34 and 57-65, and in wattages of 15, 25 and 50. Bulletin No. 4897, recently issued by the General Electric Company, illustrates and describes the new lamps in detail.

TRIPLEX PUMPS.—Bulletin No. D-205 of the Deane Steam Pump Company, Holyoke, Mass., contains an extensive discussion of the construction of its triplex power pumps of the vertical, double-acting type. It explains the advantages of the triplex machine over other forms of power pumps, principal among which is that the combined discharge from the cylinders is practically uniform in quantity and pressure. The pumps listed range in size of cylinders from 2 in. x 3 in. to 13 in. x 12 in., and in outputs from 11.5 gal. to 2475 gal. per minute.

DIRECT-CURRENT SWITCHBOARDS.—In Bulletin 4902, recently issued by the General Electric Company, are listed direct-current switchboards of 125 volts and 250 volts for controlling three-wire generators up to 200-kw rating and two-wire or three-wire feeder circuits up to 1200 amp. These panels are so designed that the appearance of both the front and back of the switchboard will be neat and uniform. The instruments, circuit-breakers, switches, etc., composing the equipment of these panels are shown, and the bulletin contains connection and dimension diagrams of various panels.

BUSINESS NOTES.

THE IMPERIAL MANUFACTURING COMPANY, maker of washing machines for electrical operation, has moved its factory to Sand Springs, Okla.

YARNALL-WARING HOUSE ORGAN.—The Yarnall-Waring Company, of Philadelphia, is putting out an interesting little magazine called the *Blow-Off,* which will be circulated gratis among stationary engineers.

LOS ANGELES ENGINEERING & EQUIPMENT COMPANY.—The Engineering & Equipment Company has been organized, with headquarters in Los Angeles, Cal. The company will have a large warehouse in that place and do both engineering and contracting work. Mr. L. G. Hooper is general manager.

THE PHILADELPHIA STORAGE BATTERY COMPANY has opened a new office in the American Building, Broadway and Columbus Circle, in New York, in order to facilitate the handling of its increasing business in electric-vehicle batteries and other types of batteries used in the automobile trade. The new office is in charge of Mr. Walter L. Thompson, the New York representative of the company.

SOOT EXTRACTOR.—A test is being made at the electric generating station of the Clinton (Mass.) Gas Light Company of a turbine-driven soot extractor designed by Mr. E. J. McCarthy, Clinton. The extractor is operated by steam under boiler pressure, and is equipped with a water-jet absorber which delivers the soot from the combustion chamber suspended in liquid to facilitate piping it away from the boiler-room. About five minutes are required in cleaning a combustion chamber.

"OUR ANCIENT LINEAGE."—As a Christmas greeting to electrical men the Cutler-Hammer Manufacturing Company, of Milwaukee, distributed some clever nonsense verses written by Mr. Charles L. Benjamin, of the company, on "Our Ancient Lineage." These couplets undertake to say that "If you want to know who were the first electrical engineers, you must go back in history for years and years and years." Thus Noah "was the earliest victim of an overload of juice," this fact showing that "they had blow-outs on the ark." Moses "was the first conductor, for he led the exodus." However, the Egyptians "made resistance," but were "thoroughly water-cooled." The serpent in the Garden receives credit as "the first to wind a coil," and "this it was, in brief, that led to the invention of the laminated leaf."

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED DEC. 19, 1911.

[Prepared by Robert Starr Allyn, 16 Exchange Place, New York.]

1,011,896. FUSE; A. Akin, East Orange, N. J. App. filed May 10, 1911. A fuse and heat coil to protect against overload and "sneak" currents.

1,011,898. METALLURGY OF ZINC-BEARING LEAD SULPHIDES WITH OR WITHOUT SMALL ADMIXTURES OF OTHER METALS; E. A. Ashcroft, Sogn, Norway. App. filed April 9, 1910. Treatment of concentrates from refractory ores, etc., with fused metallic chlorides and electrolysis.

1,011,899. METALLURGY OF METAL SULPHIDES; E. A. Ashcroft, Sogn, Norway. App. filed April 9, 1910. Separation of zinc sulphides containing lead, silver, iron, manganese and antimony, by chlorination and electrolysis.

1,011,900. METALLURGY OF METAL SULPHIDES; E. A. Ashcroft, Sogn, Norway. App. filed April 9, 1910. Zinc sulphide is heated with fused zinc chloride and then electrolyzed.

1,011,910. FITTINGS FOR SUPPORTING ELECTRIC CONDUCTORS; T. Buchholz, Kalk, Germany. App. filed July 15, 1907. A notched bar and profile rods for insulators.

1,011,919. SYSTEM OF MOTOR CONTROL; H. W. Cheney, Milwaukee, Wis. App. filed April 15, 1909. Reversible compressible resistance type for alternating current.

1,011,925. TELEGRAPHY; P. B. Delany, South Orange, N. J. App. filed Dec. 31, 1908. Automatic chemical recording instrument using currents of opposite polarity for dots and dashes.

1,011,939. ELECTROSTATIC MACHINE; F. Ghilarducci, Rome, Italy. App. filed July 2, 1908. A Holz machine with the stationary disk in two parts.

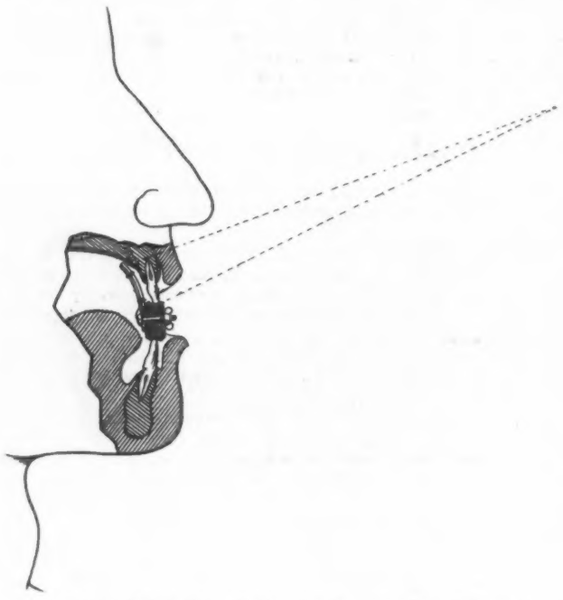
1,011,942. THERMOSTAT; J. D. Gould, New York, N. Y. App. filed Feb. 5, 1909. Tubular members. Improvement over Patent No. 774,847.

1,011,944. INDUCTION MOTOR; A. M. Gray, Milwaukee, Wis. App. filed April 3, 1909. Squirrel-cage windings; cooling and short-circuiting means.

1,011,956. ELECTRIC LOCK; E. H. Hild, Philadelphia, Pa. App. filed Feb. 23, 1911. Door lock to be operated from a distance electromagnetically.

1,011,980. ILLUMINATING INSTRUMENT; H. T. Martin and J. F. Golden, Baltimore, Md. App. filed Nov. 30, 1910. A small lamp in an exploring instrument for dental and surgical use.

1,011,992. DRY BATTERY; D. L. Ordway and J. W. Brown, Lakewood, Ohio. App. filed Oct. 23, 1909. The cells are thin parallelopipeds for compactness.



1,012,561.—Mouth Film Holder for Roentgen-Ray Skiagraphs.

1,012,010. SELF-WINDING CLOCK; T. B. Powers, London, England. App. filed March 11, 1911. Rewound by an electromotor periodically energized by automatic closing of the circuit.

1,012,020. ELECTROMAGNET; C. E. Scribner, Jericho, Vermont. App. filed March 12, 1910. Adjustable support for the armature for harmonic bells.

1,012,027. CONTROLLER; E. W. Stull, Milwaukee, Wis. App. filed March 31, 1910. A switch in series with the motor for preventing arcing at the controller.

1,012,064. RAILWAY-TRAFFIC-CONTROLLING APPARATUS; F. L. Dodgson, Rochester, N. Y. App. filed March 12, 1903. Fluid pressure motor and devices to avoid danger in case of crossed wires.

1,012,066. INDICATOR FOR TELEPHONE SWITCHING APPARATUS; H. W. Dunbar, Newark, N. J. App. filed April 8, 1910. An indicator slide between two tilting buttons.

1,012,077. METHOD OF MAKING HOMOGENEOUS MECHANICAL JUNCTURES; A. B. Herrick, Cleveland, Ohio. App. filed Nov. 25, 1904. Electric welding of copper bonds to rails.

1,012,079. RELAY; W. K. Howe, Buffalo, N. Y. App. filed May 6, 1907. Railway-signaling circuit-breaker.

1,012,080. TRAFFIC-CONTROLLING DEVICE; W. K. Howe, Rochester, N. Y. App. filed Dec. 3, 1909. Semaphore electrically operated and having a centrifugal governor.

1,012,081. RELAY-CONTACT MOVEMENT; W. K. Howe, Rochester, N. Y. App. filed March 11, 1911. Reversible rigid contacts.

1,012,096. BATTERY TERMINAL; W. H. Pearce, Summit, N. J. App. filed Sept. 9, 1909. A flaring skirt to prevent creeping of the fluid.

1,012,102. COUPLING; J. Sachs, Hartford, Conn. App. filed Nov. 5, 1908. A U-clamp and nut for drawing the end of one cable or conduit to the side of another.

1,012,125. SWITCH KEY; E. B. Craft, Hackensack, N. J. App. filed May 14, 1910. Switch springs for a telephone key.

1,012,145. ELECTRIC CUT-OUT; T. E. Murray, New York, N. Y. App. filed June 29, 1911. A base block with a removable fuse case with a cover.

1,012,146. ELECTRIC SYSTEM FOR DISCHARGING EXPLOSIVES; R. E. Noble, Chicago, Ill. App. filed March 22, 1909. For firing a number of shots successively and recording the fact of explosion.

1,012,149. PROCESS FOR THE PRODUCTION OF HALOGEN DERIVATIVES OF HYDROCARBONS; I. Pfeifer and E. Szarvasy, Budapest, Austria-Hungary. App. filed April 3, 1911. A gaseous mixture of the hydrocarbon and the halogen is subjected to silent electric discharge.

1,012,150. FLUSH ATTACHMENT-PLUG RECEPTACLE; C. D. Platt, Bridgeport, Conn. App. filed Oct. 14, 1910. For a reversible or a polarity plug. The plug is convertible.

1,012,198. ELECTRIC-MOTOR STARTER; C. L. Goughnour, Canton, Ohio. App. filed April 19, 1911. A centrifugal switch for a single-phase alternating-current motor.

1,012,209. TESTING APPARATUS; L. V. Lewis, Wilkinsburg, Pa. App. filed May 21, 1910. A voltmeter or ammeter with a case acting as an adjustable slide for the contained coil.

1,012,217. MICROPHONE; G. A. Nussbaum, London, England. App. filed Jan. 28, 1911. Perforated plates form a granule cell.

1,012,231 TELEGRAPHY; M. O. Anthony, Englewood, N. J. App. filed June 9, 1909. Special induction coil winding. Improvement on Patent No. 783,604.

1,012,240. ELECTRIC SWITCH; F. B. Bowers, Penn Yan, N. Y. App. filed Oct. 12, 1910. Pull socket for incandescent lamps.

1,012,257. DYNAMO-ELECTRIC MACHINE; F. Jeffrey, Milwaukee, Wis. App. filed Feb. 14, 1910. Rotating field; wedging members to prevent the field coils from bulging.

1,012,298. APPARATUS FOR INDICATING THE CONDITION OF STORAGE BATTERIES; E. M. Tormin, Newton Center, Mass. App. filed Feb. 25, 1910. A hydrometer is employed to indicate the specific gravity of the electrolyte.

1,012,326. ELECTROTHERAPEUTIC APPARATUS; C. E. Campbell, Lynn, Mass. App. filed Nov. 10, 1909. A casing with a transformer, a condenser, a high-frequency coil and a switch for obtaining differing effects.

1,012,335. FIRE-ALARM SYSTEM; O. De Champ, Everett, Mass. App. filed Dec. 15, 1910. The call-box number is visually displayed and also sounded.

1,012,381. DYNAMO-ELECTRIC MACHINE OF THE HOMOPOLAR TYPE; F. H. Loring, London, England. App. filed March 13, 1911. The field is built up of corrugated rings nested together.

1,012,384. BURGLAR-PROOF KEYLESS ALARM LOCK; J. Lyon, Dayton, Ohio. App. filed Dec. 9, 1909. To co-operate with the usual door lock.

1,012,387. TREATMENT OF BRINE; G. W. Malcolm and F. T. Munton, Davenham and Winsford, England. App. filed March 25, 1910. Electrochemical method of removing magnesium and calcium salts.

1,012,456. RADIO-TELEPHONY; G. Seibt, Berlin, Germany. App. filed Dec. 20, 1907. The resistance of the microphone is made equal to that of the system in order to obtain maximum efficiency.

1,012,461. TERMINAL BUSHING FOR ELECTRIC BATTERIES; J. R. Sloan, Altoona, Pa. App. filed June 9, 1911. A cupped passage and a packing nut.

1,012,470. APPARATUS FOR ELECTROLYSIS OF FUSED ALKALI CHLORIDES; E. Steinbuch, Monthey, Switzerland. App. filed Aug. 22, 1910. A diaphragm between vertically separated electrodes.

1,012,477. ALTERNATING-CURRENT-MOTOR-CONTROLLING APPARATUS; A. Sundh, Yonkers, N. Y. App. filed Oct. 31, 1908. Acceleration of induction motors for elevators, etc.

1,012,496. WIRELESS RECEIVING ELECTRIC SYSTEM; C. Wirth, Nuremberg, Germany. App. filed Dec. 20, 1910. To prevent interference with systems for controlling automobile torpedoes, etc.

1,012,524. APPARATUS FOR AUTOMATIC REGULATION OF RECTIFIERS AND ROTARY CONVERTERS; F. B. Crocker, New York, N. Y. App. filed July 25, 1904. Inductive action; no moving parts.

1,012,525 ELECTRIC SWITCH; M. H. Cullen, Chattanooga, Tenn. App. filed Oct. 15, 1909. A locking device for motor ignition systems, etc.

1,012,531. PROCESS FOR THE MANUFACTURE OF SOLID-FASHIONED BODIES CONTAINING SILICON CARBIDE; G. Egly, Charlottenburg, Germany. App. filed Oct. 16, 1905. Silicon carbide, silicon and glycerine heated in a mold.

1,012,549. ELEMENTS FOR ELECTRIC RHEOSTATS; J. W. Hoffman and H. M. Rogers, Lansing, Mich. App. filed March 11, 1911. Two concentric tubes for dipping in a liquid.

1,012,561. MOUTH FILM HOLDER FOR ROENTGEN-RAY SKIAGRAPHS; A. H. Ketcham, Denver, Col. App. filed March 20, 1910. Has an extension to be held between the teeth in taking skiagraphs of teeth roots.

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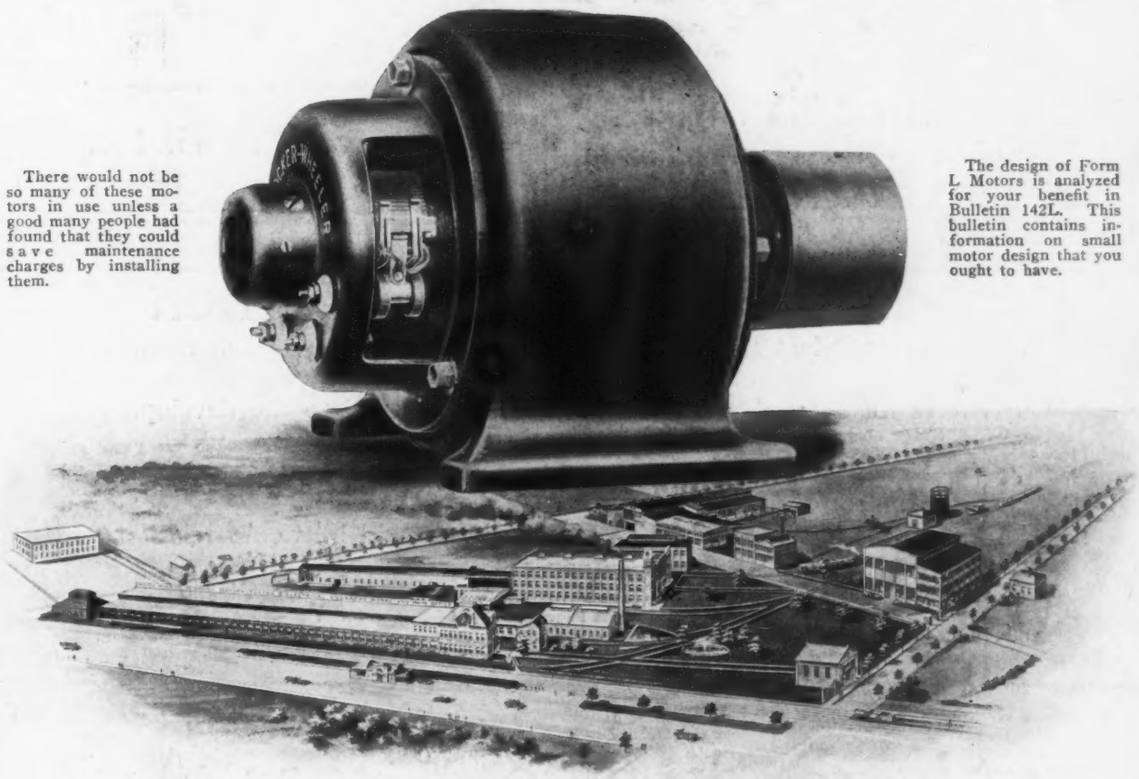

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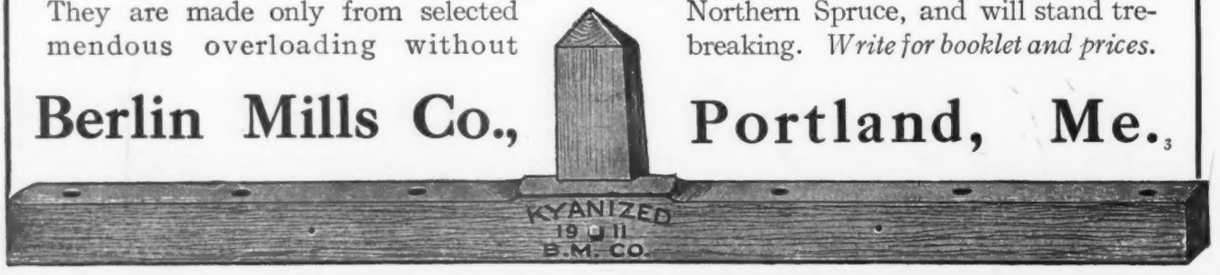

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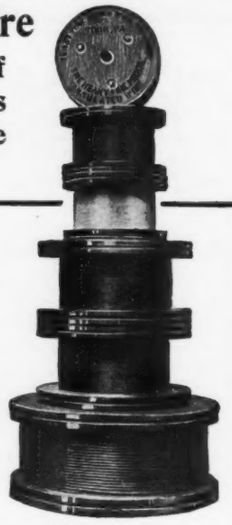

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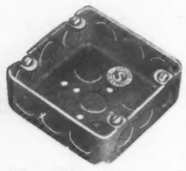

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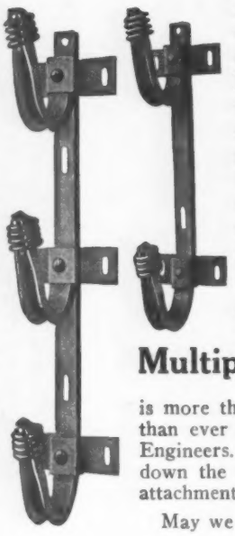

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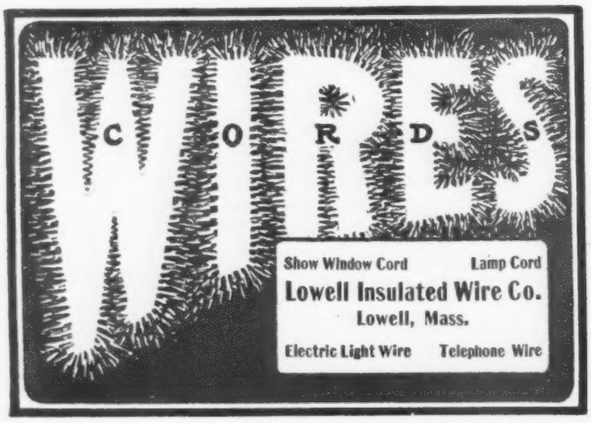

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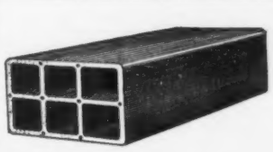

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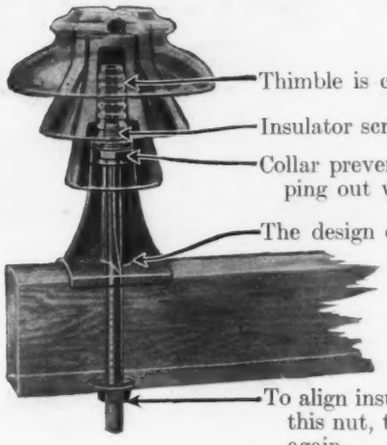
Thimble is cemented to insulator.
Insulator screws to stud bolt here.
Collar preventing stud bolt from dropping out when insulator is removed.
The design of the base prevents turning, adds greatly to the strength, and prevents rotting of the wood at the bolt hole.
To align insulator with the wire, loosen this nut, turn insulator; then tighten again.

The Improved Truss Pin Use It—It Pays

Haven't you often wanted an insulator pin that made it possible for you to adjust the groove in the insulator in alignment with the wire?

And at the same time you get perfect alignment to have the insulator perfectly tight and rigid as it should be?

You can do this with The Improved Truss Pin. Study over these illustrations and you'll see how.

First of all, the thimble or top is made separate, and is cemented into the insulator at the factory. This assures a good job—a job better than can ever be obtained on the field.

The base casting is cored out, and is provided with a recess at the top for holding the stud bolt. This bolt is threaded on both upper and lower ends; it projects far enough above this casting to permit the insulator with the thimble to be screwed on, and far enough below the cross arm for a nut and washer to be applied.

Note how simple this construction is; how well and carefully every part is designed and made; how the bases of the pins are designed to conform to the shape of the cross arm; how this prevents turning and eliminates rotting of the wood at the bolt holes.

Note the quickness and ease with which insulators may be put up; how easy a matter it becomes to remove a damaged insulator, and to substitute a new one for it; how easy it is to align the insulator with the wire.

All these general advantages you get with this pin. You can and will realize many more depending on your local conditions.

Get our new book—"The Improved Truss Pin." A book of value to you. Ask for *your* copy right away.

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Railway Material and Electrical Supplies

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Hudson Terminal
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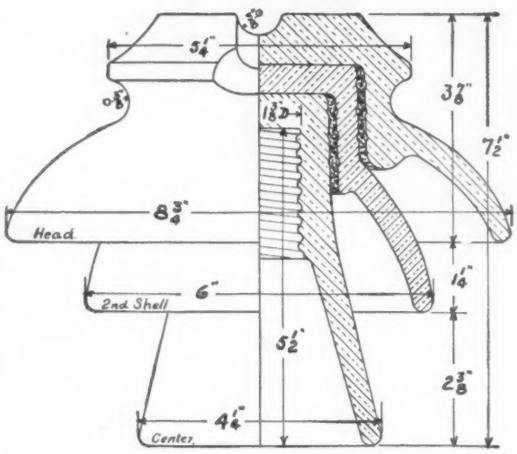
Thomas Insulator No. 3008



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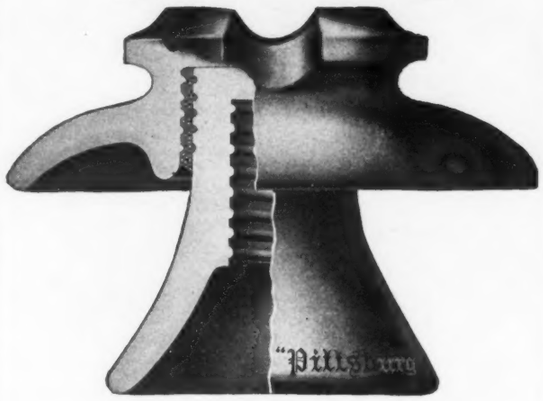
"Pittsburg"



INSULATORS

have had a very noticeable effect in freeing many high-tension transmission lines from breakdown and costly replacements and interruptions to service.

They are designed and made to give high service efficiency under severe conditions. For all voltages from 4000 to 200,000.

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2

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GLASS INSULATORS

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THE BROOKFIELD GLASS COMPANY

MANUFACTURERS

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Note Protection at Corners

Blake Insulated Staples

Unequalled for telephone and bell wiring. The fibre insulation prevents troublesome short circuits and grounds.

5 Sizes. Pat. Nov., 1900

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ENGINEERING EQUIPMENT & SUPPLY CO., Montreal.
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Ⓑ

IMPORTANT ANNOUNCEMENT

On January 1, 1912, the agency agreement for the sale of O-B Overhead Materials, Rail Bonds and Car Equipment Specialties which has been in force between the Ohio Brass Company, of Mansfield, Ohio, and the Pierson-Roeding Company, of San Francisco, for a number of years, terminates and will not be renewed, as it was mutually agreed that separate agency agreements for O-B Hi-Tension Insulators and O-B Electric Railway Equipment would eventually prove unsatisfactory and that the interests of all concerned would be better served by a single agency for the entire O-B line.

On and after January 1, 1912, the Holabird-Reynolds Company, of San Francisco, who for some time past have been acting as exclusive agents for O-B Hi-Tension Insulators only, will become the exclusive agents of The Ohio Brass Company for the sale of its entire line in the State of California.

The Holabird-Reynolds Company will carry an adequate stock of O-B Railway Materials and Hi-Tension Insulators at San Francisco and business in Los Angeles and the southern part of the State will be handled by Mr. H. C. McCutchan, of their Los Angeles office, under the personal direction of Mr. R. D. Holabird.

The business in the States of Washington, Oregon, Idaho and in British Columbia will be in charge of The Ohio Brass Company's own personal representative, Mr. F. V. Cook, who will make his headquarters in Seattle, at the office of the Holabird Electric Company. An intimate and friendly business connection between that company and The Ohio Brass Company will be maintained because of their California Agency for O-B Materials.

Arrangements are being made to carry an emergency stock for quick delivery in Seattle.

Every effort will be made to handle all orders and inquiries in such a way as to merit a continuance of patronage and to render O-B Service eminently satisfactory to Pacific Coast Customers from every standpoint of price, delivery and quality of materials furnished.

The Ohio Brass Co., Mansfield, O.

Perfect, dependable groundings are the keynote to your whole wire equipment. Lightning arresters, Telephone and Telegraph Systems, no matter how perfect, all depend for their efficiency upon *perfect groundings*. A copper plate buried, or a wire stuck in the ground, is *not sufficient*.

PARAGON GROUND CONES

are the latest, best, most reliable and cheapest groundings. Adopted exclusively by U. S. and Canadian Governments and now used on all progressive systems everywhere. Never burns or bakes out. Resists heaviest lightning discharges.

A hollow cone of pure copper perforated to afford ample discharge surface and packed with charcoal or coke to attract moisture, keeping the earth constantly damp and ground perfect.

Costs little. Easy to install—just bore a hole and drop cone in—and only one-fourth labor of old way. Up-keep nothing.

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at any time to make any specially "ticklish" kind of spring you might want.

Never mind what its work, we make you a Dunbar spring of dependable efficiency and accuracy.

Do your asking now.

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Dunbar Brothers Co.
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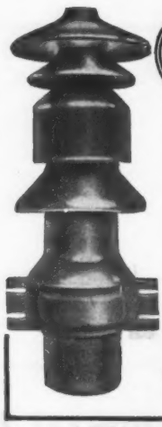

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POT HEADS

made for every purpose. All cable-ends can be made switching and testing points of your system. Originators of Pot Heads with wiping eliminated. Detachable, Non-detachable. Combination.

SUBWAY BOXES SERIES SWITCHES
and other devices made for every work where underground cable is used fully described in our new Catalog No. 6. Send for it.

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of every description from flat stock or wire. We make special springs to the customer's order only. Send us a sample or sketch and let us quote you.

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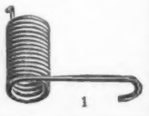

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Sending Condensers for Wireless made to stand any voltage required.
Standard Condensers a specialty. These Condensers are used in all Telegraph offices in America where Standard and ordinary Condensers are required.
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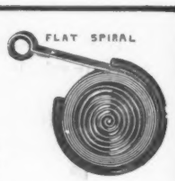

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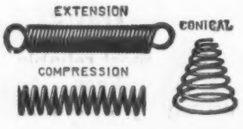

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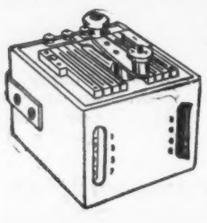

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A-C Meters
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THE STATES CO., 202 W. Water St., Syracuse, N. Y.

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Conduit Fittings

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Straightaway

When You Need Protection

—you need the quick and certain kind, the "NOARK" kind that

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always give—not every once in a while, but *always*.

Whatever the weather may be—sleet, snow, rain, hail—it makes no difference at all with these devices.

These boxes are designed along lines suggested by our own customers, by men that have since adopted the "NOARK" Line of Protective Devices because this line exactly meets their own ideas and service requirements.

Your conditions of service are not different, hence the "NOARK" Line of Service Boxes should fit right in with your own needs.

"NOARK" Service Boxes are made 2 or 3 pole from 1 to 600 amperes, 250 volts or 600 volts.

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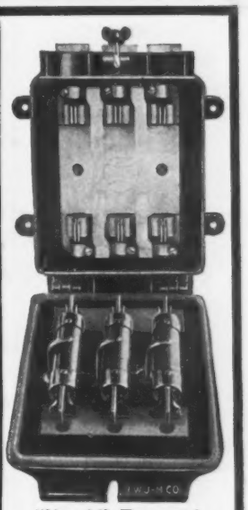

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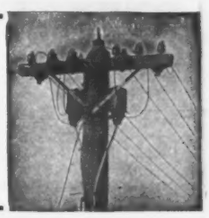

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for any insulation. Insulation equal to glass. Stands any heat. Always the same and made exactly any shape or size. Ask for book of properties.

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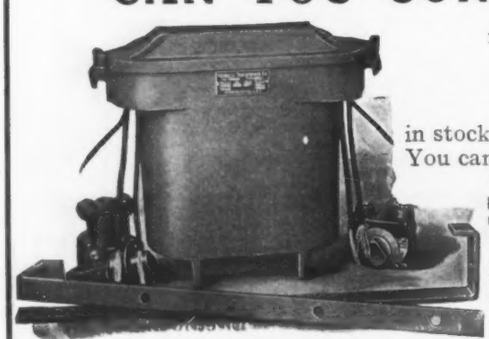

right up for quick service? You could if you had some

Peerless Transformers

in stock. And the results accruing to your station would be appreciable. You can have Peerless Transformers shipped from our nearest agency. Ask us for data.

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Transformers

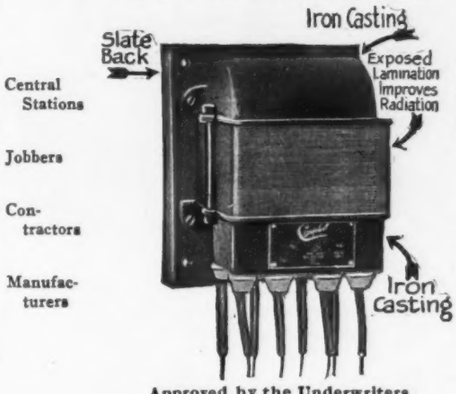
FOR

TRADE LOWVOLT MARK

TUNGSTEN LAMPS

And for

ANY OTHER PURPOSE



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You all have use for special Transformers.

Just give us an idea of what you want.

Approved by the Underwriters

Write us to-day—Do it NOW

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X-RAY and HIGH-FREQUENCY APPARATUS
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Duncan Transformers fulfill every requirement

that everyday service can impose upon them.

High all day efficiency.

Prominent in low core loss.

Persistently withstand the ravages of lightning.

Tried under extraordinary conditions with uniformly satisfactory results.

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Twenty Years' Service from the same Transformer

is some service. But that's a bona fide record of more than one

Packard

TRANSFORMER

And more—they are still delivering transformer efficient service. And every Packard Transformer is built to deliver just as durable, high all-day efficiency as over twenty-five years' experience can teach.

Naturally low core and copper losses, good radiation, low temperature rise, are pre-eminent features of all Packard Transformers. Bulletin No. 10 gives full details.

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A blind man could tell when an "Arkless" Indicating Fuse

has been blown. Note how the indicator spring stands out like a sore thumb. We will replace free of charge, without word or argument, every "Arkless" Fuse that fails to indicate when blown. "They never fail." Why not try a few.

Detroit Fuse & Mfg. Co. DETROIT, MICH.

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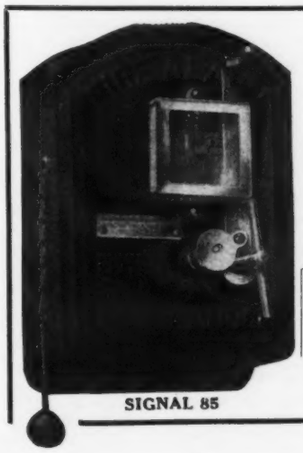

SIGNAL 85

This Tag on a Fire Alarm Box means that it has the Official Approval of the *National Board of Fire Underwriters* and when your property is protected by this system you are entitled to a

REBATE ON YOUR INSURANCE

UNDERWRITERS' LABORATORIES
INSPECTED FIRE & WATCH BOX
No 49900

Facsimile of Official Tag of the National Board of Fire Underwriters

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Relay Station

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The ability to stand up and do the work year after year with the minimum attention and lowest operating cost stamps the

"National" Storage Battery

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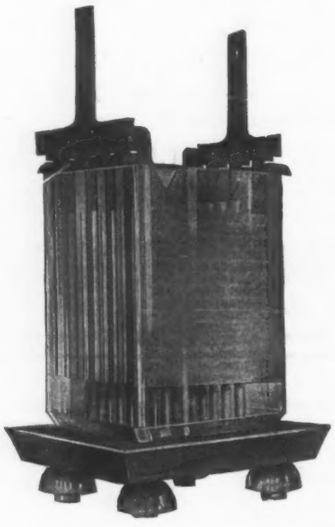

Wherever there is a place for a stationary battery the National, from every standpoint, belongs there. Place it in the same service right alongside of other makes and see how it works and lasts.

Such a test always results in more Nationals.

Manufactured by

The United States Light and Heating Company

General Offices: 30 Church St. New York

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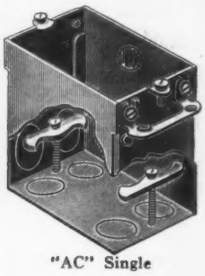
Boston Cleveland Chicago

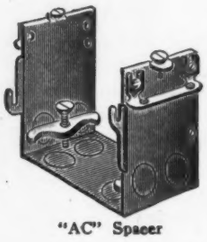
ORIGINATORS
of the
Sectional Switch Box

While there are many imitations on the market, the original and standard Sectional Switch Box always carries the "Union" trade mark.



"AC" Single

Patented April 2, 1907 for Old and New Work.



"AC" Spacer

Do you want a Box with clamps for securing flexible conduit without the Special Bushing and Lock-nut, or Boxes in Gang or Tandem, or do you prefer a Solid Drawn Box?

The Union line of Boxes is complete. Catalog No. 25 shows a Box for every requirement.

CHICAGO FUSE MFG. CO.

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THE CAMPAIGN FOR IMPROVED SERIES
Street Lighting CAN BE SOLVED
BY THE A. W. SYSTEM
Over-50-Over
PROGRESSIVE MANAGERS
Have Investigated
PURCHASED AND
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This modern system unequaled for simplicity, flexibility, economy, high power factor.

Send for our New Engineering Treatise.

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PACKARD ELECTRIC COMPANY
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The "Ironclad-Exide" Battery

will run an electric car **more miles** with **less attention** and at **less expense** than any other battery made. It can be kept in perfect order without daily attention. It does not quit on a hill or when starting a heavy load. It is the vehicle battery for either cold weather or hot.

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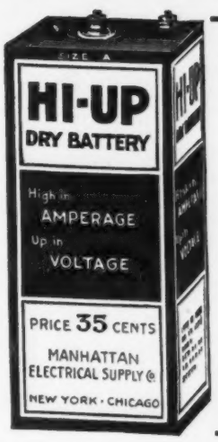

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ACCURATE, HAND GRADUATED, CLEARLY READ SCALES, WITH UNBREAKABLE WINDOWS

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For central station service, propelling street cars, electric vehicles, low voltage lighting systems, etc. WRITE FOR LITERATURE.

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that are well made and accurately calibrated. Watch type—light weight. In leather case for carrying.

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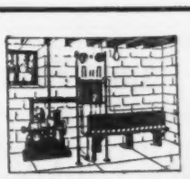

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A Perfected Speed Indicator

We illustrate here, one model of the Hopkins Electric Tachometer — the *modern speed indicator*—the type which is, to-day, universally accepted as beyond criticism.

This indicator is electrically operated and, for that reason, *positive* in action. No complicated mechanisms imperil its accuracy, nor render it liable to derangement and breakage. The

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"No Flexible Shaft"

Consists (see cut of Model M. B.) of a small D. C. Magneto (which may be driven by direct connection or by gears or belting), an easily read indicating meter and an armored, two-wire connecting cable for carrying current. The beauty of the "Hopkins," besides its absolute accuracy, is its *great convenience*. The two-wire cable may be *any length* desired—a feature which permits the installation of the indicator at a distant point—as, for instance, the superintendent's or manager's office. This perfected speed indicator is made in both portable and stationary types; portable type being used largely for experimental work, and stationary type for marine, power plant, factory and shop—in fact, any and all kinds of speed testing. If you are interested, we invite correspondence. Write for booklet giving full information.

Model M. B.
Stationary Tachometer

This tachometer—like all other Hopkins Speed Indicators—can be made a standard for other speed indicators. It has no lost motion, is not affected by temperature, and reads absolutely accurate at all speeds. Has an evenly divided scale.

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A perfect transformer operating on ordinary alternating-current lighting circuit. Will ring one three-inch box bell and a buzzer. No moving parts, no liquid to stain or freeze, therefore eliminating inherent disadvantages of batteries. Economical because no renewals necessary. Every house on a lighting circuit can be sold.
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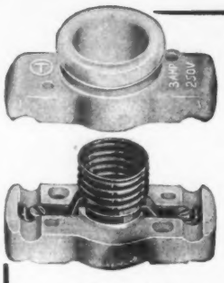

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Cat. No. 944. List 25c. Std. Pkg. 250 (10 in a box). Discounts. Trumbull, Schedule B.

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Durability—Low Price

Two features which make

FREEMAN SOCKETS

appeal to jobber, contractor or user.

Pendant, wall, bracket or fixture types.

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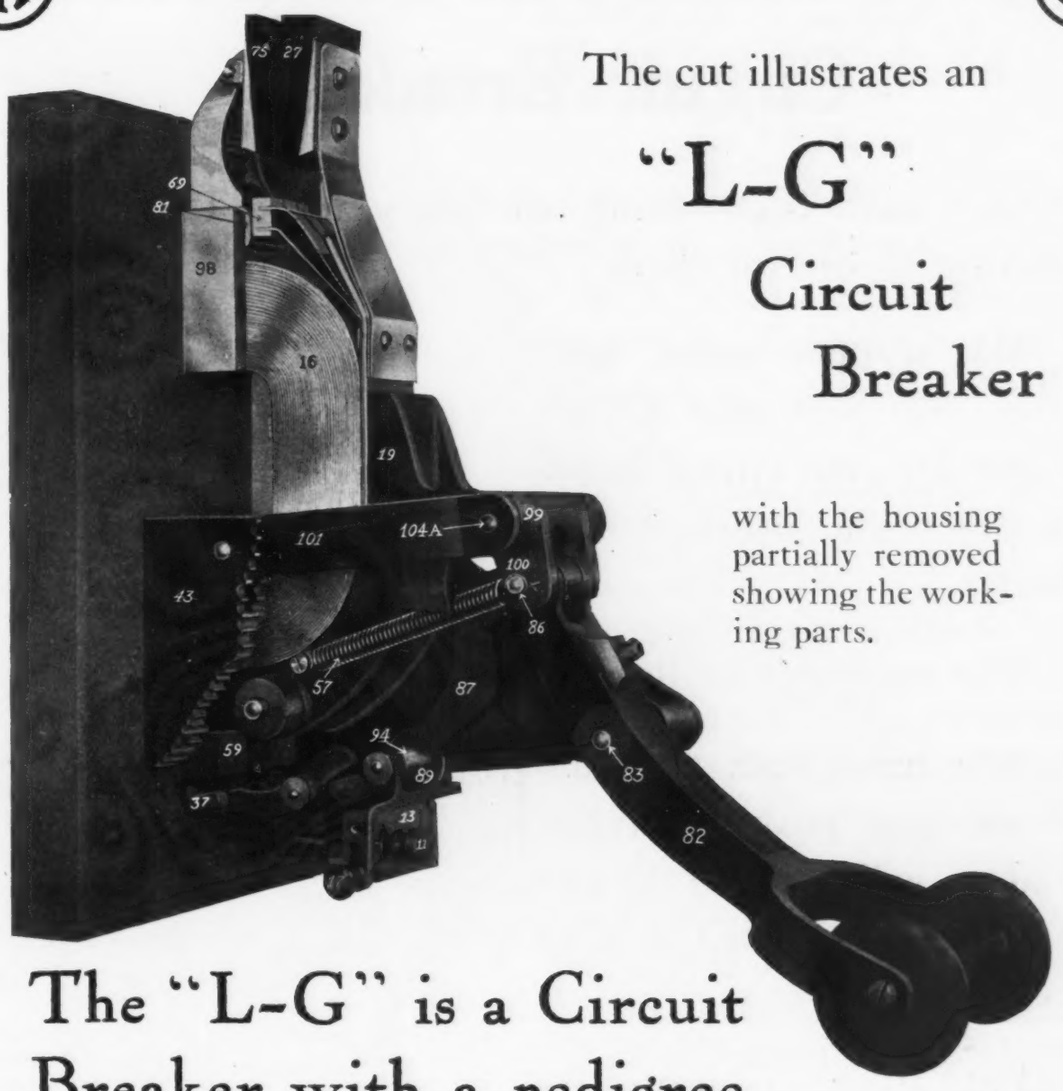

The cut illustrates an

"L-G" Circuit Breaker

with the housing partially removed showing the working parts.

The "L-G" is a Circuit Breaker with a pedigree

the outcome of years of persistent and progressive development. It embodies all that is best and most progressive in circuit breaker design. It combines the utmost mechanical simplicity with perfect effectiveness of operation. The "L-G" Circuit Breaker is made in sizes of from 2000 to 15,000 amperes. It is fully described in the new I-T-E CIRCUIT BREAKER HAND BOOK.

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H. W. MacVaugh, 1122 Park Bldg., Pittsburgh, Pa.
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Eccles & Smith Co., 68 First St., Portland, Ore.
Burton R. Stare, Seattle, Wash.
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Yes, We Make Pull-Down Handle Circuit Breakers

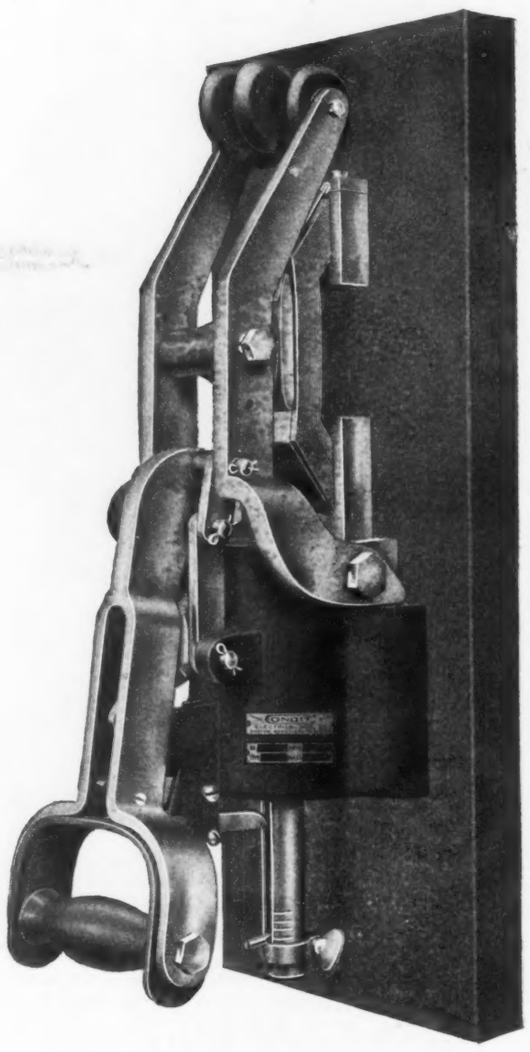
—and have been doing so for years. This is a picture of one of them.

We do not insist, however, that you take a pull-down for your circuit breaker when the other type is better.

Our standards are flexible.

We have both the pull-down and push-up types, and we will sell you the one which is best suited to your needs.

Put all your protective problems up to Condit—if he hasn't apparatus in stock that will meet your requirements he will design it.



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Northern Electric & Mfg. Co., Limited, Montreal.
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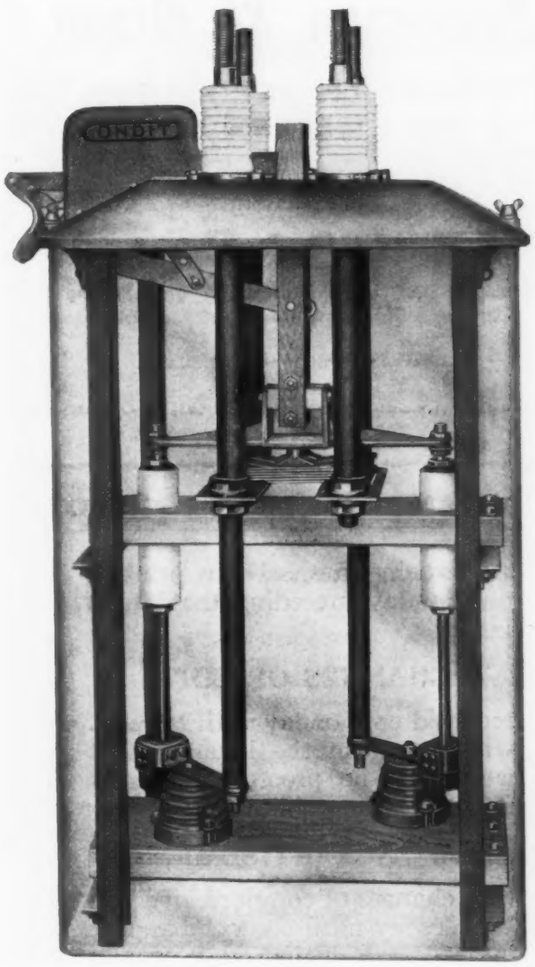
This "F. H." Switch Will Open More Energy

than any other oil switch ever made. It has a large amount of oil over the contacts, has a heavy main contact for carrying the current, and a "husky" auxiliary contact which will break the current under a large head of oil.



All of the contacts, primary and secondary, are always under the oil at all positions of their travel.

We do not use air switches to carry most of the current and put only the secondary under oil. Neither have we got a lot of useless air spaces about the switch. Every cubic inch of the switch is filled with oil, and the oil pot is dead. Live oil pots, that have to be separated by large air spaces, cost money and reduce the breaking capacity of the switch.

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Manufacturers of Electrical Protective Devices

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The Hand Is Strong, Though Light

You have seen that the indicating hand of the Eveready direct-current meter is made of a single piece of metal, instead of many pieces. You immediately recognized the advantages of fewer processes in manufacture and less chances for trouble when the instrument is in use. But in addition to these advantages, this construction gives strength and lightness.

Dimensions being equal, a single piece of metal naturally would be preferred for strength, to several parts glued together. But in the Eveready indicating hand there is an additional reason for strength. The shank of the indicating hand is a flat bar—not a tube.

Constant striking against the side of a delicate tube would be very likely to dent it, and once dented it would soon bend or break. In the Eveready meter only the edge of the shank (a flat aluminum bar) comes in contact with the cushion spring. There is no chance of denting or bending it.

There are several other ways in which trouble is avoided and strength obtained in the Eveready meters. Get a copy of our bulletin No. 323 and become acquainted with them. It will be mailed upon request.

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(not changes of copy) received on Wednesday until noon can appear in the issue of that week, but no proofs can be shown.

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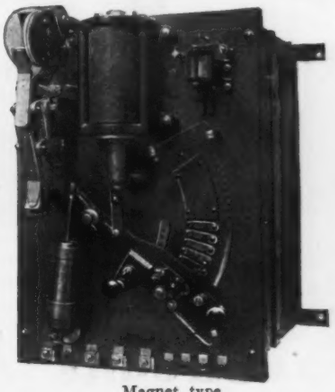
before printing, changes of copy and copy for new advertisements must be in our hands *ten* days in advance of the date of publication.

The paper is dated every Saturday.

ELECTRICAL WORLD

Carpenter type controller.

Drum type controller.



Magnet type controller.

Face plate type controller for small job presses

CUTLER-HAMMER

PRINTING PRESS CONTROLLERS

The Cutler-Hammer line of printing press controllers includes apparatus for every type and size of press—single motor, two motor, four and eight motor equipments. This company has been designing and manufacturing motor control apparatus exclusively for nearly 20 years. We are pioneers in the development of controllers for printing presses.

Hand-operated, semi-magnetic, and full magnetic or automatic types are made, each in various styles to suit every possible condition. For other machinery found in the pressroom we have just as complete lines of motor starters and speed regulators.

Carpenter Types

There are over 100 standard types and sizes of Carpenter Type Controllers. Practically every refinement of control can be provided. The operation is by means of a forward and backward moving handle. These controllers are the original Carpenter type, often imitated but never equalled.

Magnetic Types

The magnet type provide automatic control of the press from small control stations, which may be placed at different parts of the press, convenient for the operator. The action of the controller itself is entirely automatic, protecting the motor and press at all times.

"The Kohler System" of Control

"The Kohler System" of magnetic printing press control embraces the highest developed line of printing press controllers on the market. By means of push buttons, smooth starting, accurate, precise and infallible speed control, slow down, quick stop, etc., can be easily accomplished.

In New York and Brooklyn there are over 250 Kohler equipments, over 150 in Chicago, 50 in Philadelphia, and in Washington every daily paper has this system. There are also twenty or more installations in the Government Printing Plant.

Put your printing press control problems up to Cutler-Hammer. Whether for a large newspaper establishment or for a small job printer; for a combination of the largest web presses down to a small flat-bed press, Cutler-Hammer can best provide the control equipment for each case. You are also assured of the backing of the largest manufacturer of motor controlling apparatus in the world.

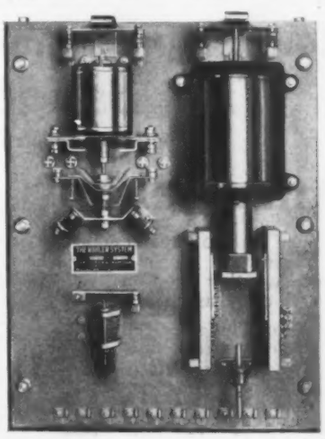
Standard apparatus for both direct current and alternating current equipments can be furnished.

This type of Kohler controller is for use with job rotary or flat bed presses.

With this controller one push button station is usually located for the convenience of the feeder and another at the delivery end.

From either station the operator can start, increase or decrease the speed, bring the bed of the press to any desired position, and stop the press.

The pressman can also lock the press when working in the machinery by pushing a "Safe-Stop" button. Possibility of injury to press or motor is also eliminated.



THE CUTLER-HAMMER MFG. COMPANY Largest Manufacturer of Electric Controlling Devices in the World. **Milwaukee**

NEW YORK, Hudson Terminal. CHICAGO, Peoples Gas Bldg. BOSTON, 176 Federal St. PHILADELPHIA, 1201 Chestnut St. PITTSBURGH, Farmers' Bank Bldg. CLEVELAND, Schofield Bldg.

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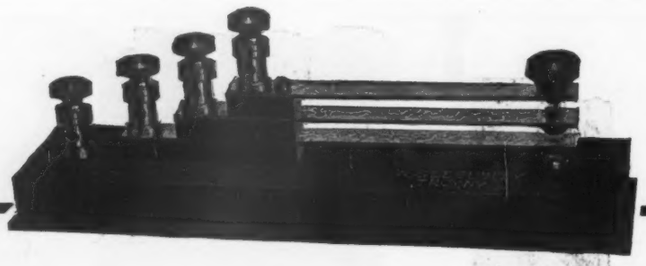
Write to-day for Printing Press Control Literature.

Any of Our Offices Will Answer Your Inquiry Promptly.



This Double Contact Key Is Essential Where Two Circuits Are to Be Closed

¶ It is particularly useful in Wheatstone's bridge experiments, as it closes the two circuits in succession.

¶ The upper contact closes the battery circuit, the current through the bridge and coils thus being made to assume a steady condition before the galvanometer is connected.

¶ The springs are long, of hard-rolled German silver and so mounted that all are of the same length, thus giving the key an easy, even touch.

¶ Ask for our Catalog of Laboratory and Electrical Testing Apparatus.

Manufacturers of Surveying Instruments, Standard Weights and Measures, Accurate Thermometers

W. & L. E. GURLEY TROY, NEW YORK

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Rough Roads Can't Injure The Sangamo

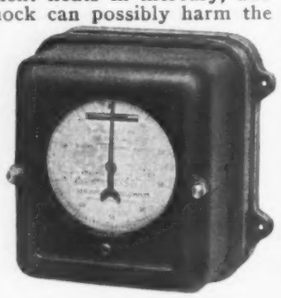
"Built Like A Watch"

Amperehour Meter

because its moving element floats in mercury, and no amount of jar or shock can possibly harm the meter, whether used on a truck or pleasure car.

You can always tell at a glance exactly how much energy is left in the battery.

Every Central Station Manager should write **to-day** for detailed information.



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Hand Tachometer

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Indicating and Recording

Gauges Thermometers
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Specify "Industrial" Efficiency Instruments
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New York Foxboro, Mass., U. S. A Chicago

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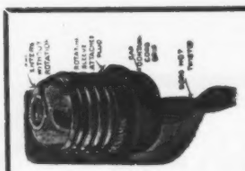

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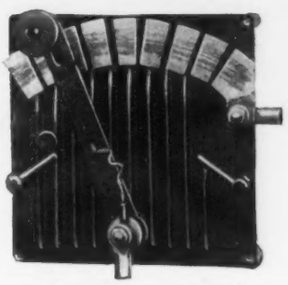
PLATING DYNAMO FIELD RHEOSTATS

For Low Voltage Self-Excited Generators

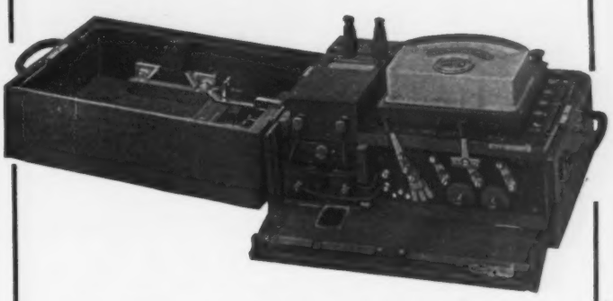


We Build a complete line of Plating Rheostats for Individual Tank and Line Control

Volts	AMPERES First Step	AMPERES Last Step	Ohms of Rheostat	List Price
5	20	4	1.0	$8.00
5	40	8	0.5	8.00
5	60	12	0.33	9.00
5	80	16	0.25	14.00
5	100	20	0.2	16.00
6	18	3.6	1.2	8.00
6	36	7.2	0.6	8.00
6	54	10.8	0.4	9.00
6	72	14.4	0.3	14.00
8	15	3	2.0	8.00
8	30	6	1.0	8.00
8	45	9	0.66	9.00
8	60	12	0.5	14.00
8	75	15	0.4	14.00

Ward Leonard Electric Co. Bronxville N. Y. 2

"S-H" Standardizing Set



"The Siemens & Halske Standardizing Set is well adapted for the accurate checking of switchboard instruments (especially where stray fields of constant intensity exist) and service Watthour-Meters in position. It is also well adapted to checking portable indicating instruments where the accuracy desired is not greater than that afforded by reading the milli-voltmeter of the Standardizing Set of 0.2 of a division."
—*From Report of Electrical Testing Laboratories.*

Write for Descriptive Bulletin 706

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Electrical Measuring Instruments

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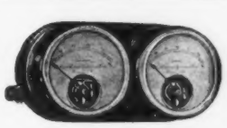
Be sure to visit our new Exhibition Room



A distinguishing, we might almost say exclusive, feature of the

HOYT

Line of

Ammeters and Voltmeters

is their extreme flexibility, adapting them to practically every use required in modern practice.
Ask for Bulletin E.W.

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CONDENSERS

Variable condensers. Fixed condensers of all capacities and dielectric strengths.
Experimental and Commercial Wireless Telegraph Apparatus.

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KEYSTONE QUALITY

This Keystone Ammeter is supplied of accuracy guaranteed sufficient for scientific and laboratory work.

In the regular Keystone instruments of this type perfect balance between inductance and capacity has been so nearly secured that no appreciable error is found in its indications.

For use on Alternating or Direct Current without modification.

Ask for Catalog No. 14 complete with details.

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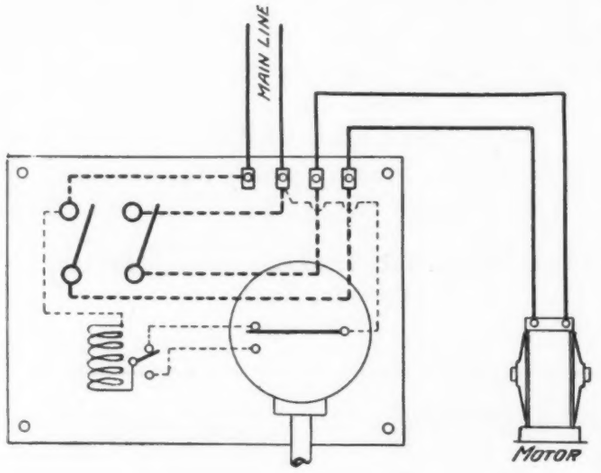
THERMOMETER
FOR
GENERATORS, TRANSFORMERS, ETC.

A tough, flexible bulb, less than 1/25 inch thick, is inserted into or built into the vitals of machine and the temperature accurately read on indicator. The distance separating the bulb and indicator is without effect upon the accuracy. Any number of bulbs may be read upon one indicator with selector switch. With proper installation accuracy ½° C. or better.

This is the thermometer to use in machinery; first, because it gives the temperature of the center, the hottest part of the machine and not its air or oil-cooled surface; second, because the temperature is read at the switchboard and not at out of the way places over the machines.

THE LEEDS & NORTHRUP COMPANY
ELECTRICAL MEASURING INSTRUMENTS 7
4903 STENTON AVENUE PHILADELPHIA, PA.

This Diagram Shows How Simple It Is



to wire up a Sundh Pressure Regulator for starting a small motor without the use of a starting resistance.

The double pole type of Pressure Regulator is shown, but in many cases of Direct Current and single-phase Alternating Current, a single pole type can be used. It may be also adapted for starting A. C. Motors of two or three phases, three wire, or two phases, four wire when it is permissible to open two circuits and to run the neutrals direct to the motor.

The Sundh Catalog contains detailed information. Shall we send it?

SUNDH ELECTRIC COMPANY
NEW YORK, U. S. A. 2

No. A-5597 Switchboard. Efficient design, most compact and thoroughly accessible. 30 lines capacity.

"Hello! Mr. Brown, Manager? Yes—He Is In the Plant—I'll Locate Him in a Second and Have Him Talk to You from Wherever He Is"

The Instantaneous Service with the Code Call and General Alarm Telephone System. No Additional Bells, Circuits, or Special Ringing Apparatus

The No. A-5597 P. B. X. Switchboard

Increases the efficiency of your inside organization just as the outside telephone has made it possible to extend business operations a thousand fold.

"Just a minute" may be of vital importance—it often means a lost business opportunity. But with the P. B. X. Switchboard every member of your organization can be reached instantly, whether he is at his desk or in the most remote part of your plant. It saves running about, climbing stairs, loss of time, chance of mistakes. Information is obtainable, and instructions may be given personally, without waiting or interrupting an interview at what may be the critical moment in an important transaction.

The P. B. X. Switchboard saves time at every turn. One minute with it will do business that ordinarily requires ten.

And now we offer you an added time-saving feature in the

Code Call and General Alarm Telephone System

One extra key mounted on the key shelf of the No. A-5597 P. B. X. Switchboard, enables your operator to code ring every bell on the system at the same time without interrupting or annoying any conversation that may be going on in the office or factory.

By this additional feature any member of your organization may be found and talked with in a second, whenever he is wanted, wherever he may be. The officers of your company as well as others having regular duties in the plant are at liberty to leave their desks and get closer in touch with the daily problems of their business. This new system is now being successfully used by Bausch & Lomb Optical Co.; D. Armstrong & Co.; Gleason Tool Works; L. Adler Bros. & Co., of Rochester, N. Y., and many other well-known firms.

Think of the increased efficiency—the saving of time, trouble, and money it will mean in *your* office, factory or store. Just dictate a note on your letterhead *now* asking for our interesting, illustrated free *Booklet No.* 2907 and full particulars about this wonderful efficiency increasing system. A diagram of your factory and a statement from you as to the types of telephones desired, will enable us to give you a complete estimate of the cost of equipping your plant with modern Quality Telephone apparatus.

Directors Room

Shipping Dept.

Reception Room

Stock Room

Foundry

Purchasing Dept.

Sales Dept.

Supt. Office

Stromberg-Carlson Telephone Mfg. Co.

Rochester, N. Y., U. S. A.

Chicago, Ill.
Los Angeles, Cal.

Toronto, Can.
San Francisco, Cal.

Kansas City, Mo.
Seattle, Wash.

Now is the Time to Push Sales of the

SIMPLEX

Electric Heating Pad

For all the demands which the cold weather creates

Replaces the Hot Water Bottle

"Will not cool off" stays hot as long as desired.

Temperature Automatically Controllable.

Light and Flexible may be used in any position.

Soft and Soothing to the most sensitive skin.

As a Foot Warmer it is much used by invalids and elderly people.

Always Ready for instant use.

Cost of Using about ¼ cent per hour.

Send for descriptive circular

Simplex Electric Heating Co.
CAMBRIDGE, MASS.

New York 25 W. 42nd St. | Chicago, Monadnock Block Belleville, Ont. | San Francisco 612 Howard St.

SIMPLEX ELECTRIC QUALITY

HOSKINS

"Electricity to Heat"

—has these advantages:

cleanliness—it is free from products of combustion,

uniform distribution,

precision and *ease* of control,

high temperature available in a compact space.

The field for "Electricity to Heat" is not only a broad one, but is growing rapidly as its benefits are continually making themselves felt.

The needs of this field are met by the line of "Hoskins" *Electric Furnaces*.

In these the advantages of "Electricity to Heat," are brought to industrial service through the application of the "Hoskins" *patented* Nickel-Chromium *resistance element*.

To grasp the importance of "Electricity to Heat" and to know the means by which you can best profit by it—an investigation of the "Hoskins" Products is worth your time—*now*

Write to-day for our "Bulletins"

Hoskins Manufacturing Company
Electric—Furnaces, Pyrometers and Heating Appliances
467 Lawton Avenue, DETROIT. 283

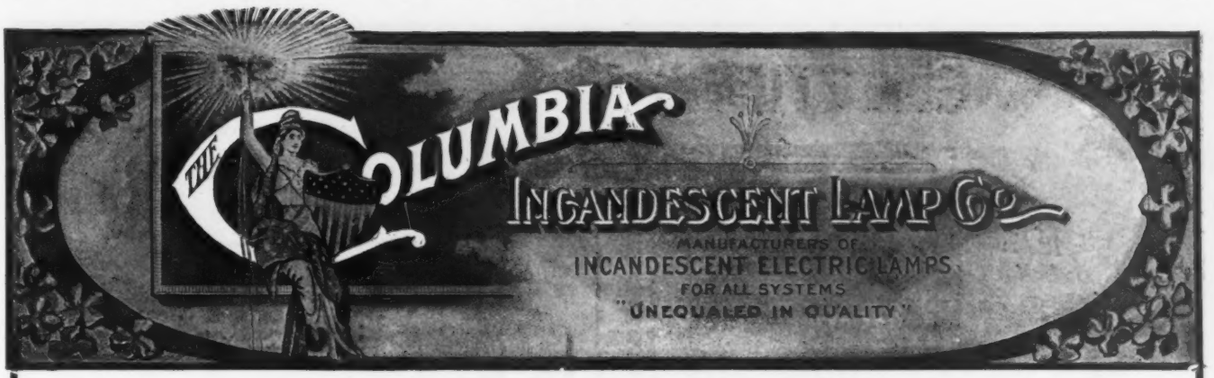
Latest Addition to World's Market of Electric Heating Devices

Delco Ornamental Stove

Especially designed for use on the dining table. Neat, efficient, fool-proof and moderately priced.

Equipped with three heat indicating snap switch.

Diamond Electric Company
Binghamton, N. Y.



Are *You* a *Careful* Lamp Buyer?

The careful lamp buyer is appealed to by Columbia Lamps and Columbia Service: because, they stand the exacting quality tests and give satisfaction.

Progressive effort has kept Columbia Lamps in the forefront for 22 years. Progressive effort has developed the Columbia Drawn Wire Mazda Lamp. Progressive lamp buyers specify Columbia Mazdas because they give tripled light and tripled service.

Our "Mazda Line" now includes lamps for every service.

We manufacture all sizes of Carbon, Gem, Tantalum and Mazda lamps.

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Established 1889

Equitable Building, St. Louis, Mo.

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New York, Suite 406, 225 Fifth Avenue
Philadelphia, 1221 Real Estate Trust Building
Chicago, 320-326 South Fifth Avenue
Denver, 231 15th Street
Minneapolis, 909 Security Bank Building
Memphis, Randolph Building
Dallas, 713 Elm Street
San Francisco, 155 New Montgomery St.

The Shelton Electric Hair Dryer

Throws both Hot and Cold air. Weighs only 2 lbs. Built to run on 110 volts direct and alternating currents; also 220 volts.

The Shelton Electric Vibrators are standard the world over.

We manufacture 20 different styles of massage machines. Dealers! There is money made in selling Shelton Vibrators and Hair Dryers. Agents wanted everywhere. Write for catalog and quotations.

SHELTON ELECTRIC CO.

13 W. 42d Street
New York

BRANCH
30 E. Randolph St.
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LINDSTROM, SMITH COMPANY

218 SOUTH WABASH AVE., CHICAGO

Manufacturers of White Cross Electric Vibrators

Electric Irons, Electric Hair Dryers, Small Electric Motors, Medical Batteries, Therapeutic Lamps, Electric Stoves and Toasters.

Electric Hair Dryer.

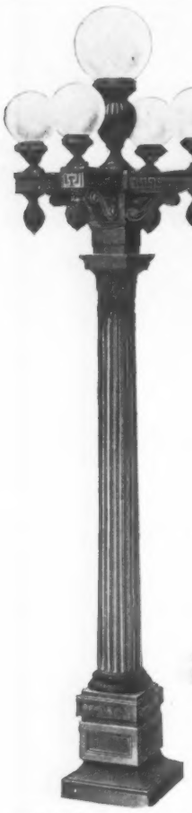
Electric Vibrator. 10 Different Styles.

Small Electric Motor.

Electric Iron.

Electric Stove and Toaster.

Send for Our Catalog No. 58



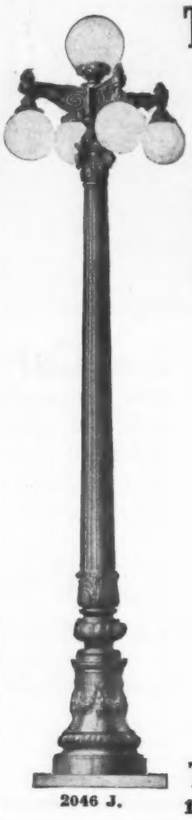
Corinthian Standard
Patented

GREETINGS

MAY that light which illumines the road to prosperity burn steadily for you. - - -

Now You Know!

FLOUR CITY ORNAMENTAL IRON WORKS
Minneapolis, Minn.



2046 J.

TUNGSTEN POSTS

For Street Lighting

ARC LAMP POLES, BRACKETS

Ornamental Lighting Posts for all purposes.

We have just what you require among our thousand different models.

We manufacture all posts used for N. Y. City lighting.

Catalogues and special designs on application.

Correspondence solicited

The J. L. Mott Iron Works
118-120 Fifth Ave., New York City

High Efficiency

Reflectors

"Opalux" "Camia"
"Gletieco" "Carrara"

Artistic and Efficient

"The Glass Without the Glare"

THE OPALUX COMPANY

258 Broadway, New York City

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Pettingell-Andrews Co.,
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Chicago, Ill.

Canadian Representatives,
Canadian General Elec. Co.,
Toronto, Canada.

Eastern Representatives,
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The Artificial Lighting

OF THE

Cathedral of St. John the Divine

IS PRODUCED BY

Frink Reflectors

St. Louis, Mo. Cleveland, O. **I. P. FRINK** San Francisco Cal. Seattle, Wash.

24th St. & 10th Ave.
NEW YORK

2

Samson Spot Cord

WATERPROOFED

Outlasts all other cord and all metal suspension devices. It provides the most economical method of suspending arc lamps. The proof is yours for a word.

Also samples.
Write.
Trade Mark Reg. U. S. Pat. Off.

Samson Cordage Works
BOSTON

1

ECONOMICAL, EFFICIENT LIGHTING

of streets, parks, boulevards, etc., is best secured by use of

UNION LAMP STANDARDS

(PATENTED)

Where one lamp is sufficient for present needs, as in thinly settled districts, it is not necessary to install a new standard when there is a later demand for more light, as additional arms may readily be attached.

Union Lamp Standards are very different from the ordinary foundry product. The only cast iron parts are the base and top—the shaft is made of such high grade material as Toncan Metal which may bend, but will not break.

Union Lamp Standards can be furnished painted, or with copper, brass or bronze finish, at prices that will make the use of cast iron standards seem extravagant.

Write for further particulars and list of over 100 other cities where installations have been made.

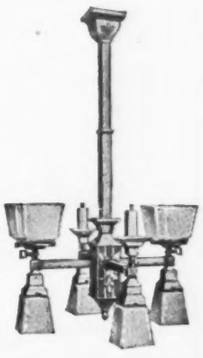
The Union Metal Manufacturing Company, *Sole M'f'r's.* CANTON OHIO

Our New "Highland" Line of Electric, Gas and Combination Fixtures

The same methods as used in the manufacture of our portables will be adopted in these fixtures and when shipped they will be mechanically correct, plumb and square.

These fixtures are winners and prices low. Line includes fixtures of all kinds, Tungsten fixtures, showers and brackets.

Write for Illustrations and mention "Highland" Line



The Goodwin & Kintz Co.

Station C, Winsted, Conn.

ELECTRICAL SUPPLIES

THE CHEAPEST IN THE EAST COMPARE OUR PRICES

Approved Rubber-Covered Wire, No. 14....$5.50 per M
Push-Button Switches with plates..... .35 each
Snap Switches..... .12½ each
LOOM .....17.50 per M. 4.50 per coil

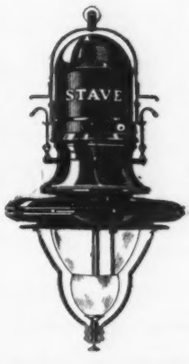
M. RUTKIN ASK FOR PRICES 287 15th Avenue, NEWARK, N. J.

STANDARD RENEWED LAMPS—9 CENTS

BOSTON INCANDESCENT LAMP CO.
DANVERS, MASS.

"STAVE"

The Longest Life from the Shortest Flaming Arc Lamp



100-135 Hours per Trim

Strong, sturdy carbons—globes always clean.

One pair of carbons only—No Magazine.

Total height of lamp is but 32"

Positive, steady feed produces unflickering white or yellow light.

550 watts—3000 C. P.

Burns on 10 amp. constant potential and constant current circuits.

The Lamp for City Lighting, Factory Lighting, Any Lighting

Stave Electrical Company

Main Office: 131 Hudson St., New York

Western Office: 452 Monadnock Block, Chicago, Ill.

Canadian Representatives: Engineering Equipment and Supply Co., Montreal, Can.

Does The Lamp Owner Understand?

By the lamp owner is meant any one who has to do with the operation, maintenance, costs, or purchases of flaming arc lamps of the inclined feed types.

Do they understand? Do they realize what we have been trying to impress on them from week to week through the pages of this and other publications about the economy and reliability of Silvertip Flaming Carbons?

What we have said are facts that can be backed up by the personal knowledge of any lamp man.

All that is necessary to prove these statements of longest life, greatest illuminating power and lowest cost is to make a single test. That will tell the story. You may have enough free samples to make this test, for the asking. They will be sent by prepaid express. You should accept this offer, for you want best results for least cost and labor.

Address E. W.—11

National Carbon Co. Cleveland Sixth City **Cleveland, Ohio**

Why bother with the unknown, when the

Cadillac Electric Combination Stove and Toaster

offers you the sales security of the *known?* Ten months' national advertising in the leading women's magazines has given the Cadillac a nation-wide reputation as the best and most practical. Special pre-Christmas advertising in large space makes *now* the right time for you to show the Cadillac in your windows. Christmas Cadillacs are specially packed in holly gift boxes that your customers will appreciate. Retail price $7.50, with a fat profit for you. Wire your order at our expense.

Cadillac Electric Mfg. Co.
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ELECTRIC SEARCH LIGHTS

7-inch to 36-inch diameter for ocean, lake and river steamers and launches; also electric light plants driven by gasoline engine for isolated lighting.

The Carlisle & Finch Co.
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CINCINNATI, OHIO

DUCTILE TUNGSTEN FILAMENT

We would pay liberally for good quality of above material or any information as to its manufacture

VACUUM GLASS CO., Lynn, Mass.

The Moore Light
"Comes in Long Vacuum Tubes."

Yellow Light The Best Illumination for Large Areas

White Light A Duplication of Daylight. The Only Light for Color Matching.

The Moore Light Window is factory-built
Send for description.

Moore Light Co., Newark, N. J.

INNER ARC GLOBES
INCANDESCENT BULBS, TUBING & CANE
Write for Prices. The Lippincott Glass Co., Alexandria, Ind.

"Excello"

FLAMING ARCS

of all types are

Standard

Before purchasing try them

THE EXCELLO ARC LAMP COMPANY

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CLEVELAND: 337 Superior Avenue, N. W
BOSTON: 184 Franklin Street
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Hygrade

Not the Label but what the Label stands for

Send for our Independent Proposition

HYGRADE

Tungsten Sign Lamp
5 watts
10 to 13 volts
List 40c
Guaranteed Life
2,000 hours

Hygrade Incandescent Lamp Co.

136 Liberty Street, New York
Factory, Danvers, Mass.

Philadelphia, Chicago, Seattle
St. Louis, Pittsburgh

Electric Soldering and Branding is more efficient and economical than any other method
"Vulcan Trade Mark"

Soldering and Branding Irons

are the ONLY successful Electric Soldering and Branding Tools on the market.
The manufacturers of your city should use the VULCAN System of soldering and branding.
Central stations and supply dealers write for full information.

VULCAN ELECTRIC HEATING COMPANY
1110 Military Road, Buffalo, N. Y.

FOR AUTOMATIC MOTOR STARTERS, LIFTING MAGNETS, CONTROLLERS, ETC.
CONSULT
THE ELECTRIC CONTROLLER & MFG. CO.
CLEVELAND, O.

FLAMING EXCELLO CARBONS
TRADE MARK

"Excello" Flaming Carbons

Quality of carbons has more to do with the brilliancy of light, in flaming arc illumination, than the construction of the lamp itself, which is merely the agency for maintaining the arc in operation.
"Excello" Flaming Carbons have fully proved their efficiency in the converging type of flaming arc lamp.
They give pearl, yellow, red or brilliant white light, and will give excellent results in any flaming arc lamp of the converging type.

"Electra" Carbons

For Enclosed Arc Lamps

require minimum cleaning and trimming expense, because their percentage of waste is extremely low. They are pure, fine-grained and homogeneous. Being absolutely straight and of uniform diameter throughout, they are not likely to jump or stick, and therefore help to secure steady light. "Electra" Carbons will very materially improve the performance of any good arc lamp.

Hugo Reisinger

Sole Importer of "Electra" and "Excello" Carbons

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TRADE MARK

PLANIA CARBONS TRADE MARK.

For Better Illumination Everywhere

for street, office, factory or industrial works

Plania Carbons

PLANIA CARBONS TRADE MARK.

They are the only satisfactory, homogeneous carbons for every type of lamp.
Plania Carbons for open arcs, enclosed arcs, flaming arcs, and moving picture machine.
Try them and be convinced

PLANIA CARBONS TRADE MARK.

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Dim-a-lite

FOUR CHANGES OF LIGHT

Pull the Cord— Get Four Degrees of Light—

"full-on," "dim," "low," "'way-down" and "out" —and you decrease your bill each time.

That's what the Dim-A-Lite will do for you. It's not a lamp—it's simply a turn-down attachment for standard lamps.

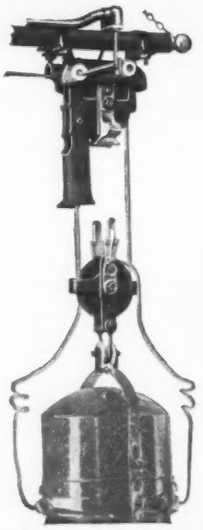
It's fireproof, foolproof and unbreakable. As easy to attach as the lamp itself. A pull on the cord and it operates.

Sample to any address, prepaid, $1.00.
Ask for full data.

Wirt Electric Specialty Company
Germantown, Pa.

Federal Electric Co., Chicago.
Canadian General Electric Co., Ltd., Toronto.
E. Simon Brunschwig et Cie., 7 Rue des Messageries, Paris.

The Thompson Automatic Cut-Out Hanger



Effectively solves the flaming arc problem.

Stops the use of huge cranes for trimming and cleaning the lamps.

Does away with unsightly and dangerous festoons of conductor wires usually seen dangling from lamps which are lowered for trimming under present practise.

Makes daily trimming and cleaning a quick and easy performance in safety on the ground, and insures increased life and efficiency for the lamps.

Ask for details.

The Thompson Electric Co.
337 Superior Ave., N. W. Cleveland, O.

There is an Inter-phone for every condition of service

There is an Inter-phone for every condition of purse

Western-Electric

TRADE MARK

SELECTIVE RINGING—COMMON TALKING

Inter-phones

This is *the* equipment for the residence or business establishments where it is desired that only one bell—that of the station called—shall ring, and where a common talking circuit will suffice.

Complete stocks at our nearest house—in three standard sizes—two, five and nine stations, both desk and wall types.

Bulletin No. 262 gives complete details. It is ready for you—write for it to-day.

WESTERN ELECTRIC COMPANY

Manufacturers of the 6,000,000 "Bell" Telephones

EVERY BELL TELEPHONE IS A WESTERN ELECTRIC TELEPHONE

New York, Buffalo, Philadelphia, Boston, Pittsburg; Atlanta, Chicago, Indianapolis, Cincinnati, Minneapolis; St Paul, Milwaukee, Saint Louis, Kansas City, Denver; Dallas, Omaha, Oklahoma City, San Francisco, Oakland; Los Angeles, Seattle, Salt Lake City, Portland

Montreal, Toronto, Winnipeg, Vancouver
Antwerp, London, Berlin, Paris, Johannesburg, Sydney, Tokyo

Address the house nearest you.

EQUIPMENT FOR EVERY ELECTRICAL NEED

"SAVE TIME AND FREIGHT"

"TELEPHONE OUR NEAREST HOUSE"

Service Economy

means vastly more than "low first cost." It means that when you install

"Diamond H" Switches and Receptacles

you have installed a product that will deliver high and continued satisfaction in service. Service that will redound to your credit and reflect upon all the rest of the job.

And this is so because every phase of switch and receptacle construction has been and is constantly being studied by our engineers. No detail is too small—no improvement so unimportant as to be slighted or overlooked in our manufacturing processes. And every detail is considered more particularly from the service end than from the standpoint of the manufacturer.

Let the H catalog help you to Switch and Receptacle Service Economy.

The Hart Mfg. Co.

Hartford, Conn.

New York Boston Chicago Pittsburg
San Francisco Denver Toronto London, Eng.

GENERAL ELECTRIC COMPANY

The City of Edison-Mazda-Light

This "city" will appear during January and February in 10,000,000 copies of forty magazines and newspapers.

It will be as far-reaching in its effect as the Edison-Dream-Comes-True advertisement which it supplements.

The following magazines, circulating hundreds (perhaps thousands) of copies in *your* territory, will carry this advertising:

Magazines	
American Magazine	Jan.
Architectural Record	Jan.
Building Management	Jan.-Feb.
Cavalier-Scrapbook	Feb.
Century	Jan.-Feb.
Cosmopolitan	Feb.
Everybody's	Jan.
Illuminating Engineer	Jan.
McClure's	Feb.
Munsey's	Jan.-Feb.
Popular Electricity	Jan.-Feb.
Review of Reviews	Feb.
Scrapbook	Jan.
System	Jan.-Feb.
World's Work	Feb.

Weeklies	
Collier's Weekly	Dec. 30
Independent	Jan. 4
Scientific American	Jan. 13-Feb. 10
Saturday Evening Post	Jan. 20
American Architect	Jan. 17

Newspapers

Assoc. Sunday Magazine, Feb. 4
Boston Post
New York Tribune
Philadelphia Press
Washington Star
Baltimore Sun
Pittsburgh Post
Buffalo Courier
Detroit News-Tribune
Chicago Record-Herald
St. Louis Republic
Minneapolis Journal
Denver Rocky Mountain News
Monthly Magazine Section, Jan. 14
Boston Globe
Philadelphia North American
Washington Post
Pittsburgh Dispatch
Cincinnati Enquirer
St. Louis Globe-Democrat
Chicago Tribune
San Francisco Call

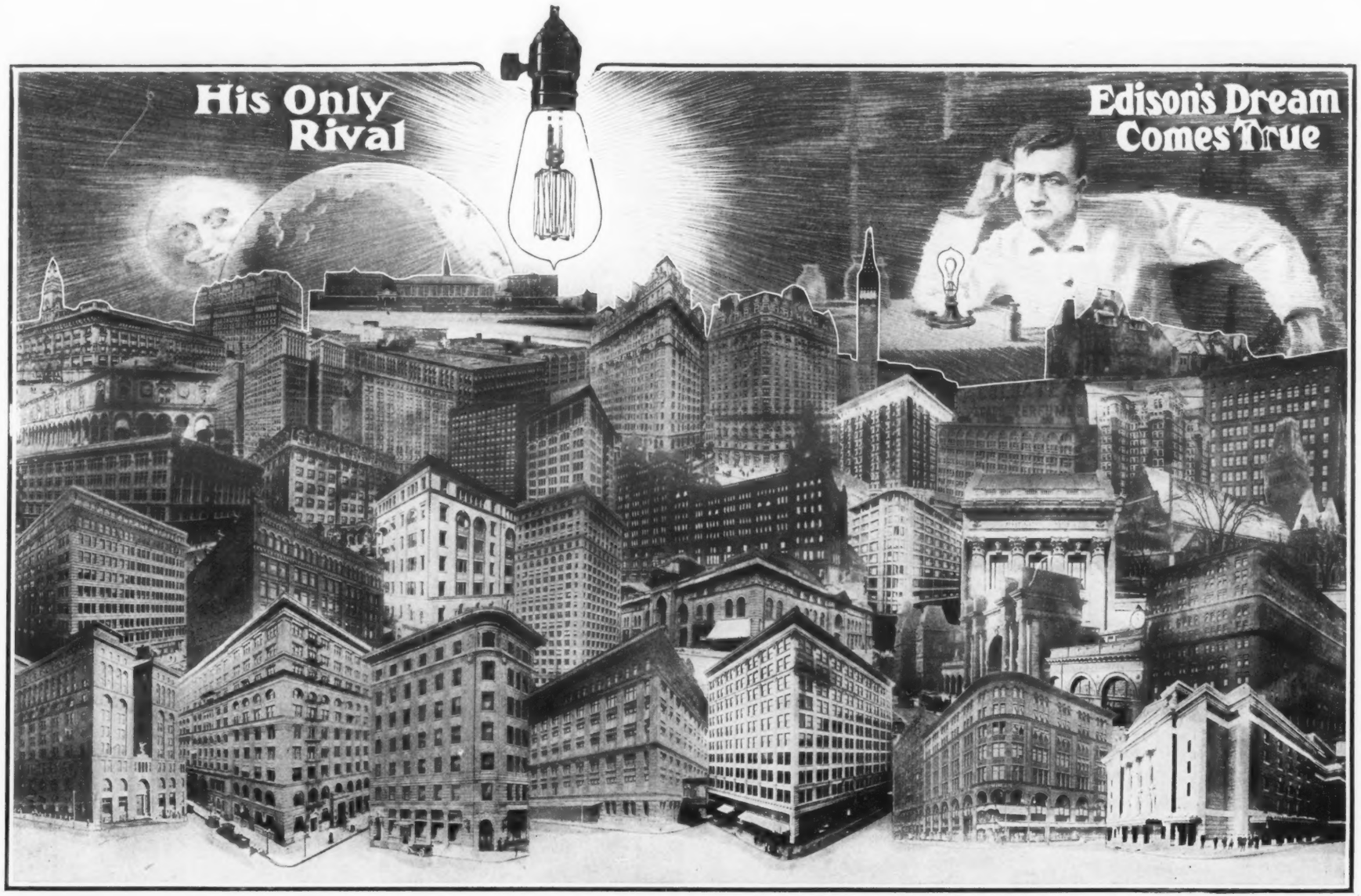
General Electric Company

Main Lamp Sales Office:
Harrison, N. J.

Principal Office:
Schenectady, N. Y.

3356

LARGEST ELECTRICAL MANUFACTURER IN THE WORLD



Lower row—Omaha National Bank Building, Omaha. Chamber of Commerce, Portland. Peoples Saving Bank, Sacramento. Pittsburg-Lake Erie R. R. Station, Pittsburg. Higgins Building, San Francisco. Gimbel Brothers, Philadelphia. Boston Opera House, Boston.

Second row—Monadnock Building, San Francisco. Dey Brothers' Store, Syracuse. Times-Star Building, Cincinnati. Land Title & Trust Building, Philadelphia. Auditorium, Canton. North (or B. & M.) Station, Boston. Central Building, New York.

Third row—Hamburger's Department Store, Los Angeles. Bellevue Hotel, San Francisco. Southern Building, Washington. Rockefeller Building, Cleveland. Wells-Fargo Building, Portland. Broad Street Station, Philadelphia. Carson Pirie Scott & Co., Chicago. First National Bank Building, Cleveland. Memorial Hall, Harvard University, Cambridge.

Fourth row—Herald Building, New York. Hudson Terminal Building, New York. Fred. Loeser & Co., Brooklyn. Bellevue-Stratford Hotel, Philadelphia. Martinique Hotel, New York. Onondaga Hotel, Syracuse. Colgate Building, Jersey City. Citizens Savings & Trust Building, Cleveland. Carnegie Building, Pittsburg.

Top row—Siegel Cooper, New York. Iroquois Hotel, Buffalo. Normal and Latin School, Boston. Metropolitan Life Insurance Building, New York. Billings Hall, Wellesley College, Wellesley.

The City of Edison-Mazda-Light

If *all* the buildings lighted by Edison Mazda Lamps could be grouped together the result would be a city composed of the leading hotels, largest stores, most modern office buildings, banks, theatres, colleges, schools, museums, hospitals, factories, railroad stations, municipal and private buildings of all kinds—and thousands of homes.

Only a very small city can be shown here, but in these three dozen buildings there are 200,000 Edison Mazda Lamps giving a total light of over 6,000,000 candlepower. Nineteen cities are represented by buildings well known locally and, in some cases, nationally. One of these is the largest and another the tallest office building in the world.

Millions of these sturdy Edison Drawn Wire Mazda Lamps are used in buildings of all kinds, on automobiles and railroad trains and in all places where any electric incandescent lamp can be used. Edison's dream of "Electric-light-for-everybody" has come true.

Begin to-day to use this lamp that gives nearly three times as much light as the ordinary carbon filament lamp consuming the same amount of current.

Your lighting company or electrical supply dealer will furnish any size from 25 to 500 watts, plain or frosted bulbs. Be sure you get Edison Mazda Lamps—the G-E monogram (GE) on the package and on the lamp is for your protection.

Which of the following 20 to 40-page illustrated pamphlets shall we send:

"The Lighting of Hotels and Cafes"
"The Lighting of Office and Public Buildings"
"A New Era In Lighting" (Homes, etc.)
"The Lighting of Iron and Steel Works"
"The Lighting of Textile Factories"

General Electric Company

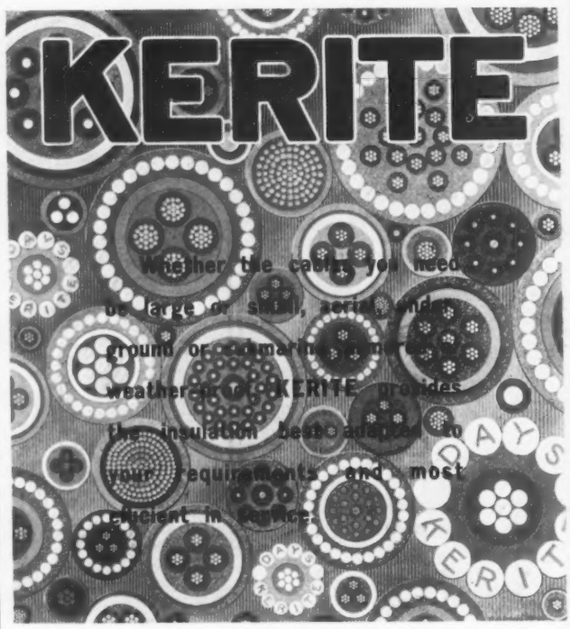
Department 33

Schenectady, N. Y.

Branch offices in over 40 cities

The Guarantee of Excellence on Goods Electrical Is the Monogram Trade-Mark of the General Electric Company

3341



Kerite Insulated Wire and Cable Company
Incorporated by W. R BRIXEY
GENERAL OFFICES
Hudson Terminal, 30 Church Street, NEW YORK
WESTERN OFFICE
Peoples Gas Building, CHICAGO 2

WEBER UNIVERSAL SOCKETS

KEY, KEYLESS, PULL } INTERCHANGEABLE { FIXTURE, PENDENT, WALL

Shell may be inserted in cap by a straight push, not in twenty or forty positions only, but absolutely anywhere (in an infinite number of positions.)

In every position they are securely locked against separation.

The lock against rotation comes into play automatically when needed.

Always Specify **WEBER UNIVERSAL** Accept No Substitutes

For sale by
ALL JOBBERS OF ELECTRICAL SUPPLIES
HENRY D. SEARS, General Sales Agent, 131 State St. Boston, Mass. 2

Round—Square—Flat
MAGNET WIRE
ALL INSULATIONS
STANDARD UNDERGROUND CABLE CO.
BOSTON, NEW YORK, PHILADELPHIA — **PITTSBURGH, PA.** — ST. LOUIS, CHICAGO, SAN FRANCISCO 3

GOOD INSULATION IS GOOD POLICY
FOR AIR DRYING AND FLEXIBILITY
USE
STERLING BLACK ARMATURE LACQUER
The Sterling Varnish Company
MANCHESTER, ENG. PITTSBURG, PA.
Pioneers in the Electrical Field 8

COAL TESTS The fuel value of coal ordinarily varies from 9,000 to 15,000 B. t. u The ash content of coal ordinarily varies from 4 p. c. to 30 p. c. Other variables are important. Tests of coal are made by us for many careful purchasers who begrudge the cost of their ash pile. Write for our coal booklet.
ELECTRICAL TESTING LABORATORIES, 80th Street and East End Avenue, New York, N. Y.

"ALUMADUCT"

EASIEST FISHED

Will Not RUST
Approved by Underwriters' Laboratories
WHITE OUTSIDE. INSULATED COATING INSIDE
Write for PARTICULARS

C. S. Knowles 7 Arch St. Boston.

Branch Offices:
New York Pittsburg Chicago
St. Louis Atlanta

Pacific Coast Agents: John A. Roebling's Sons Co.

NEW WESTON INSTRUMENTS

A Full Line of Alternating Current Switchboard Indicating Instruments

Is offered by this company, comprising

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Electrical Testing Laboratories.

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Harrison Safety Boiler Wks.

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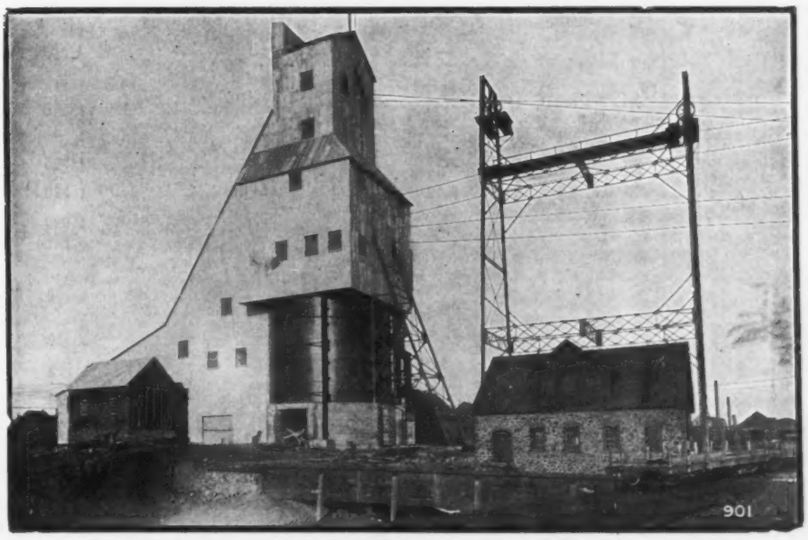

Rock House, Quincy Mining Co., Hancock, Mich.

Offices in 17 American Cities

General Office: Hudson Terminal, 30 Church Street, New York
Export Representatives: United States Steel Products Company, 30 Church St., New York
Pacific Coast Representatives: United States Steel Products Co. (Pacific Coast Dept.), Rialto Bldg., San Francisco, Cal.

Inventory Sale

SPECIAL PRICES

To comply with the rulings of the government on income tax we will close our fiscal year on Jan. 1 hereafter, where heretofore it ended on March 1. Under the circumstances our PRE-INVENTORY SALE OCCURS TWO MONTHS EARLIER THIS YEAR. This is an occasion always eagerly looked for by buyers, as we wish to close out as much as possible and makes prices acordingly.

Prices have been considerably reduced on many entire lines of machines, insuring immediate sales—keeping pace with recent developments in the trade

FOR SALE

60-Cycle Alternators

KVA.		Speed.
1 60	National, 6600-volt, 3-phase	1200
1 65	Stanley, 2-phase	900
1 75	Gen. Elec., 3-phase.	900
1 75	West., 2-phase	720
2 90	G. Elec., type AS..	900
1 90	Elec. Mach. Co., 3-phase	720
1 100	Gen. Elec., 3-ph	900
1 100	National, 3-phase, 6600 v.	900
2 100	Gen. Elec., 3-phase, type A.T.B.	900
1 120	West., 2-phase	900
1 120	West., 3-phase	900
1 150	National revolving field, 2-phase	720
1 150	National revolving field, 3-phase	720
1 150	Ft. Wayne, 1-phase.	450
1 150	West., 2-phase	600
1 150	West., 3-ph., 2300-v., revolving field direct con. Erie City Engine	225
1 150	West., 3-ph., rev. arm, comp., 220 or 440 v., dir-con. to Harrisburg stand. comp. engine	240
1 175	Stanley, 2-phase	514
1 180	West., 3-ph., 2200-volt	514
1 180	West., 3-ph., 440 v.	514
1 200	West., Elec., revolving field, 3-phase	600
2 200	Gen. Elec., type A.T.B. form D	600
1 200	Gen. Elec., 3-phase, type A.T.B., form P.	600

25-Cycle Alternators

KVA.		Speed.
1 400	Westinghouse, 3-ph., 410 v., rev. armature type, 3-bearing.	300

125-133 Cycle Alternators

KVA.		Speed.
1 30	National, 1100 v	1500
1 60	Gen. Elec., A60	1500
1 60	Westinghouse	1333
2 75	Ft. Wayne, comp	1050
1 90	Ft. Wayne, 1100 v.	1050
3 90	G. Elec., type AS.	1250
1 120	G. Elec., A120	1070

Arc Machines

		Speed.
1 6.6	amp., Brush, 8½B.	570
1 9.6	amp., Brush, 13A	750

125-Volt D. C. Multipolar Generators

Light.		Speed.
1 180	Westinghouse, 10 KW, direct con. to Westinghouse 2-cylinder gas engine	325
1 200	Crocker-Wheeler	1250
1 200	Western Elec.	1100
2 210	Western Elec.	1150
1 210	Sprague, 12½KW.	1550
1 300	Sprague, 17½KW.	1200
1 350	Northern, 20 KW.	750
1 350	Sprague, 20 KW	800
1 350	Westinghouse, MP. comp., 20 KW, direct con. to Westinghouse 2-cylinder gas engines	900
1 450	Gen. Elec., 25 KW.	1100
1 450	Sprague-Lundell	850
2 450	Sprague-Lundell	650
1 450	Gen. Elec., 6-pole, comp., 25 KW, direct-con. Fitchburg engine	305
1 540	Sturtevant, 30 KW.	950
1 540	Sprague, 30 KW.	800
1 660	Western Elec.	475
1 700	Sprague-Lundell, 40 KW	725
1 700	C. & C., 40 KW	650
1 750	Akron, 45 KW	700
1 850	Westinghouse	850
1 850	Excelsior, MP, comp., 50 KW, direct-connected to N.Y. Safety engine	300
1 1000	Northern, 60 KW.	800
1 1050	Walker, 62½ KW.	690
1 1300	Northern, MP, 75 KW, comp., direct-connected to Racine vertical engine	275

220 to 250-Volt Generators

KW.		Speed.
1 20	Gen. Elec.	600
1 20	Northern	500
1 25	Akron, MP.	1200
1 25	Allis-Chalmers	975
1 25	Westinghouse	650
1 30	Western Elec.	1200
1 30	Western Elec.	950
1 30	Allis-Chalmers	1300
1 30	Elec. Mach. Co.	950
1 30	Amer. Eng. Co.	750
1 30	Commercial	600
1 30	Ideal, MP.	600
1 30	Crocker-Wheeler	750
1 35	Northern	1000
2 35	Western Elec.	500
1 45	Northern	900
1 45	Gen. Elec.	975
1 45	Westinghouse	690
1 50	C. & C.	650
1 50	Ft. Wayne	600
1 55	Crocker-Wheeler	930
1 75	Westinghouse	750
1 100	Jenney, 6-pole, comp., direct-connected to Allfree engine	250

3-Phase, 60-Cycle, 220-Volt

H.P.		Speed.
39	6/10 Westinghouse, type CCL.	1100
	2 Gen. Elec., form K.	1200
1	3 Westinghouse, type CCL, 220 or 440 v.	1700
1	5 Richmond	1720
1	5 Western Elec.	1730
1	5 Western Elec., slip-ring, 220 v., variable speed, with drum - controller and resist	1110
1	7½ Gen. Elec., form K	1800
1	7½ Westinghouse, type C.C.L.	1700
3	7½ Gen. Elec., form K.	1200
2	10 Gen. Elec.	1800
1	10 Westinghouse, type C.C.L.	1700
4	10 Gen. Elec., form K.	1200
1	10 Westinghouse, type C.C.L.	850
1	15 Fairbanks-Morse	1200
1	15 Gen. Elec., form K.	1200
1	20 Gen. Elec., form K.	1800
1	20 Westinghouse, type C.C.L.	1700
3	20 Gen. Elec., form K.	1200
1	20 Westinghouse, type C.X.	850
3	20 Allis-Chalmers, 220 or 440 v.	850
3	30 Westinghouse, C.X.	850
2	40 Westinghouse, C.X.	850
3	50 Westinghouse, C.X.	850
1	30 Allis-Chalmers, 220 v.	850
1	60 Gen. Elec., form L, 2200 v.	720
1	75 Gen. Elec., form L, 220 or 440 v.	720
	Elec., form K, 2200 v.	720
3	100 Gen. Elec., form K, 220 or 440 v.	720
1	100 Gen. Elec., form L, 220 or 440 v.	720
1	100 Westinghouse, type CX, 220 or 440 v.	690
2	125 Gen. Elec., form P, slip-ring type, 2200 v.	600
3	150 Gen. Elec., form P, slip-ring type, 220 or 440 v.	600
1	175 Gen. Elec., form K, 2200 v.	600
1	200 Westinghouse, type C.X., 220 or 440 v.	580
1	200 Westinghouse, type C.X., 2300 v.	580

3 Phase, 25 Cycle

H.P.		Speed.
1	15 Fairbanks - Morse, 440 volts	720
1	65 Westinghouse, type C.X., 220 or 440 v.	480
1	150 Westinghouse, type C, 440 volts	480
1	200 Westinghouse, type C. X., 440 v.	480

2-Phase, 60-Cycle

H.P.		Speed.
1	3 Westinghouse, type C.C.L., 220 or 440 volts	1700
1	10 Westinghouse, type C.C.L., 220 v.	1700
1	10 Western Elec., type CS11A, 220 v.	1145
1	20 Westinghouse, type C.C.L., 220 v.	1700
2	20 Allis - Chalmers, 220 or 440 v.	850
1	200 Westinghouse, type CX, 220 v.	580

If you see a machine listed in our "Bargain Sheet" that suits you write at once and order as soon as possible. 150,000 central stations, dealers and large users also see it. Some one may want the same machine you do. "First come, first served."

GREGORY ELECTRIC COMPANY

16th and Lincoln Streets
CHICAGO, ILL.

THE PIONEER ELECTRICAL BARGAIN HOUSE—ESTABLISHED 1893

Frank MacGovern J. Warren Archer

MacGovern, Archer & Company

114-118 LIBERTY STREET PHONE, RECTOR 4337-8-9 **NEW YORK**

IMMEDIATE DELIVERY

300-Kw 60 CYCLE, ENGINE DRIVEN UNIT

1 — 300-Kw General Electric, type ATB., revolving field, 3 phase, 60 cycle, 2300 volt (Can be reconnected for 220 or 440 volts if desired) 150 RPM., direct connected to

1 — 14-28 x 30", heavy duty, four valve type, cross compound McIntosh & Seymour engine. Unit complete with

Blake Vertical Jet Condenser.
Goubert Feed Water Heater.
Steam Separator.
Standard General Electric A.C. Machine Panel.
12" Blake Atmospheric Free Exhaust Valve.

Send for full list of Dynamos, Motors, Engines and Electrical and Steam Machinery of every description.

Hudson Terminal Bldg. **DUZETS & SON** New York

Electrical and Steam Machinery

2 SPECIALS

2-350 H.P. Abendroth & Root watertube boilers, 150 lb. pressure, complete and in perfect condition. Must move immediately. Price f.o.b. cars $700.00 each.

35 K. V. A. Crocker Wheeler, revolving field, 3 phase, 60 cycle, 2300 volt alternator, 1200 R. P. M., with exciter, practically new, $350.00.

Send for complete "Bargain List" Engines, Generators, Boilers, Motors, Etc.

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MOTORS

2-PH. HP.	Make	60 CY. Volts	RPM	3-PH. HP.	Make	60 CY Volts	RPM
1	Wghse.	220	1200	1	Wghse.	220	1200
2	Wghse.	220	1700	2	Wghse.	220	1700
3	Gen. Elec.	220	1800	5	Wghse.	220	1120
7½	Wghse.	220	1700	5	Wghse.	440	1120
10	Wagner	220	1720	7½	Wghse.	440	1700
10	Wghse.	220	1120	7½	Wagner	220	1720
10	Gen. Elec.	440	1200	10	Wagner	550	1140
12½	Triumph	220	1140	10	Wghse.	220	1120
15	Wghse.	220	1120	10	Gen. Elec.	440	1200
15	Wghse.	440	1120	15	Wghse.	220	1120
25	Cro.-Wheeler	220	1800	15	Wghse.	440	1120
100	Wghse.	220	720	20	Wghse.	440	560
				25	Wghse.	220	1120
				30	Wghse.	440	850
				35	Cro.-Wheeler	550	900
1-PH.		60 CY.		40	Wghse.	440	850
5	Wghse.	110	1710	70	Cro.-Wheeler	550	720
5	Wghse.	220	1710	75	Gen. Elec.	550	514

MACHINERY BROKERAGE CO., 50 Church Street NEW YORK

350 K.W. D.C. UNIT 250 VOLTS

Westg. Generator, 8 poles, 120 R.P.M. direct connected to 24" x 36" St. Louis Corliss engine. Switchboard and Balancing Set.

St. Louis ARTHUR S. PARTRIDGE, 417 Pine St.

BELTED ALTERNATORS—2300 Volts—60 Cycle.

75 K.W.	Gen. Elec.	3-phase	Rev. fld.	900 R.P.M.
90 K.W.	Stanley	3-Phase	Inductor	900 R.P.M.
100 K.W.	Gen. Elec.	2 or 3-Phase	Rev. fld.	900 R.P.M.
120 K.W.	Gen. Elec.	1-Phase	Rev. Arm.	900 R.P.M.
3—150 K.W.	Gen Elec.	3-Phase	Rev. fld.	600 R.P.M.
175 K.W.	Westinghouse	2-Phase	Rev. fld.	900 R.P.M.
300 K.W.	Westinghouse	2 or 3-Phase	Rev. Arm.	300 R.P.M.
375 K.W.	Westinghouse	2 or 3-Phase	Rev. Arm.	400 R.P.M.
420 K.W.	Stanley	3-Phase	Inductor	360 R.P.M.

417 Pine St. ARTHUR S. PARTRIDGE St. Louis

FOR SALE

One horizontal cross-compound Hamilton Corliss Engine, direct connected to a 750-K.W., 6600-volt, three-phase, 25-cycle General Electric generator. This unit is in first-class condition, and can be seen running up until January 15th. For price apply to

BROOKLYN EDISON COMPANY
360 Pearl St, Brooklyn, N. Y.

DIRECT CONNECTED D. C. UNITS, 250 Volts.

2— 50 K.W.	Bullock	275 R.P.M.	11x14	Buckeye Eng.
50 K.W.	Crock.-Wh.	275 R.P.M.	Chase simple engine.	
75 K.W.	Westingh.	275 R.P.M.	Westinghouse vert. cross-comp. eng.	
2—100 K.W.	West Elec.	250 R.P.M.	12x18 Russell 4-valve engines.	
200 K.W.	Gen. Elec.	200 R.P.M.	16&24x18 Erie Ball engine.	
350 K.W.	Westingh.	120 R.P.M.	24x36 St. Louis Corliss engine.	
400 K.W.	Gen. Elec.	120 R.P.M.	18&36x30 Allis Corliss engine.	
525 K.W.	Westingh.	85 R.P.M.	19&44x48 A. & B. Corliss type.	
600 K.W.	Gen. Elec.	130 R.P.M.	26&46x30 Har'burg Corliss valve eng.	

417 Pine St. ARTHUR S. PARTRIDGE St. Louis

POSITIONS WANTED

The rate for "Positions Wanted" advertisements of forty words or less is one dollar an insertion; additional words, two cents each; payable in advance. Remittances and copy should reach this office not later than Wednesday, 12 o'clock noon, for the next succeeding issue.

Replies may be sent in care of Electrical World, 239 West Thirty-ninth Street, New York, or 1570 Old Colony Building, Chicago, as advertisers may desire.

ELECTRICAL and mechanical engineers, designers and draftsmen who have had any kind of experience whatever can be secured through this office gratis. Send us your inquiry when in need of men. The Engineering Agency, Inc., Monadnock Block, Chicago.

WANTED—Responsible position by man of all-round ability, having an European academic and an American technical school training; practical experience in every branch of electrical engineering field, having been with largest concerns. For the last three years engaged in electric railroad engineering work, but desire to change position and connect in New York or vicinity. Age 26. Further details and references on request. Address No. 9408, care of Electrical World, New York.

WANTED—Position with lighting or power company as manager or superintendent, by technical and practical man, 33 years of age. Have had position in the above capacity; am at present employed by large electrical manufacturing company as testing engineer. Address No. 9488, care of Electrical World, New York.

WANTED—Position with chance of advancement, by young man thoroughly experienced in the repair and testing of all kinds of A. C. and D. C. machinery, including elevators, both magnet and gravity control; technical graduate, single, thoroughly competent and reliable. Address No. 9520, care of Electrical World, New York.

PRACTICAL, energetic man, 12 years' experience in electrical construction, operation and testing, with some draughting knowledge, desires opportunity to make good with manufacturing company. Employed by civil service, U. S. Government. Good reason for leaving same. Best of references. Address J. H. SWEET, 125 No. Milton Ave., Baltimore, Md.

(*Continued on page 78*)

Your Own Electrical World

To receive your own copy of the *World* each week.
To have it to read when you want it and as long as you want it.
To keep your own file of the paper for reference.

These are the advantages of being a personal subscriber.

If you are not a regular subscriber you probably see the *Electrical World* from time to time. But, are there not times—and many of them—when you want to read the latest issue and some one else has it? Are there not many other times when you want to refer to an article in a back number but cannot find that number?

For less than 6 cents a week you can be a personal subscriber—you can get all the news of the electrical field while it is still fresh and valuable—you can have a constantly growing library of your own on all branches of electrical work.

Better Send Your Order To-Day Before It Is Forgotten

If you are not ready to subscribe for a full year now, here is an offer for you.

Trial Subscription—20 Weeks for $1.00

Name.....
Occupation.....
Address.....
Enclosed find $1.00 for which send the Electrical World to the above address for the next 20 weeks.

ELECTRICAL WORLD
239 W. 39th St.
New York
N. Y.

ELECTRICAL WORLD

239 West 39th Street New York

Don't Deliberately Damage Electrical Apparatus

by the use of the sand bucket and the water tank. When the fire occurs, play on the safe side,—for your machinery's sake, use the

Pyrene TRADE MARK **FIRE EXTINGUISHER**

An absolutely moistureless combination of gases in liquid form which will smother any incipient fire of any origin, without the slightest damage to the most delicate parts. Has extinguished *in actual tests*, electrical arcs of 54,000 volts at 9 amps. and 220 volts at 2000 amps.

Included in the list of approved fire appliances issued by the National Board of Fire Underwriters

Pyrene is used by the N. Y., N. H. and H. R. R. Co., The Interborough Rapid Transit Co.. The Brooklyn Edison Co. and hundreds of other Corporations.
Pyrene is a universal Fire Extinguisher.
Let us send you convincing data.

PYRENE MFG. CO., 1358 Broadway, New York
Address Dept. A

SPARKING

reduces the working capacity of a motor or dynamo, wears out the commutator, wastes power and may cause a fire.
All of this may be avoided if you use

The only article that will prevent sparking. Will keep the commutator in good condition and prevent cutting.
Absolutely will not gum the brushes.

It will put that high gloss on the commutator you have so long sought after

Send for Stick **50c PER STICK** **$5.00 PER DOZ.**

For Sale by all Supply Houses, or **K. McLENNAN & CO.** Sole Manufacturers.
Room 411—130 Dearborn St., CHICAGO

THE COAL & IRON NATIONAL BANK

143 LIBERTY STREET
NEW YORK

ASSETS
$8,000,000

Exceptional facilities for out-of-town accounts

2

We Finance Extensions and Improvements

to Electric Light, Power and Street Railway properties which have established earnings. If prevented from improving or extending your plant because no more bonds can be issued or sold, or for any other reason, correspond with us:

Electric Bond and Share Company

Paid-up Capital and Surplus, $5,280,000
71 Broadway, New York

Dealers in Proven Electric Light, Power and Street Railway Bonds and Stocks:

THE POLISH LASTS

if secured by means of U. S. Metal Polish. Easily and quickly applied. Does not deteriorate, scratch or injure surfaces. Sample free. 3 oz. box 10 cts. 5 lb. pails $1.00.

GEO. W. HOFFMAN 3
Manufacturer
295 E. WASHINGTON STREET, INDIANAPOLIS, IND.

COMMONWEALTH EDISON CO.

REPAIR SHOPS

32 N. MARKET ST., CHICAGO. TELEPHONE RANDOLPH 1280

FIRST-CLASS EQUIPMENT THROUGHOUT

DYNAMOS, ARMATURES, MOTORS, ARC LAMPS, INSTRUMENTS, HIGH GRADE MACHINE WORK OF ALL KINDS.

CORRESPONDENCE SOLICITED

THE MAN WHO "MAKES GOOD!"

is the man who advertises in the right paper!

The Electrical World Is the Paper!
"NOW 'MAKE GOOD!'"

POSITIONS WANTED

(Continued from page 76)

ELECTRICAL GRADUATE with good record holding responsible position with manufacturing establishment wishes to communicate with consulting engineer who wants an assistant or with contractor doing construction work. Address No. 9527, care of Electrical World, 1570 Old Colony Bldg., Chicago, Ill.

WANTED—Position as manager or superintendent of electric lighting or combination water and light plant; 18 years with one company in above capacity; satisfactory references; equally proficient in installation work; will accept foreign assignment. Address 9529, care Electrical World, 1570 Old Colony Building, Chicago.

POSITION of responsibility wanted, either executive or designing, by mechanical engineer with wide experience in electrical apparatus, who is now employed as chief draftsman; can handle men and get results; salary expected, $150.00 a month. Address No. 9535, care of Electrical World, New York.

WANTED—Position as manager or superintendent; high-voltage, long distance transmission, hydroelectric plants; street railway, gas, light and power city plants; A practical electrical engineer; an A No. 1 business man; have doubled earnings and cut operating expenses half; can do the same for you; now engaged, but would change. Address No. 9539, care of Electrical World, New York.

WANTED—Position of responsibility as chief engineer for a steam-electric power station by a Bachelor of Mechanical Engineering, technical graduate of 1894, and qualified electrical expert aid in United States Civil Service Commission, Navy Department examination of 1907; salary asked $100 per month. Address Mr. Joseph Stuart Hanna, Hotel Victoria, Chicago Heights, Ill.

TECHNICAL ELECTRICAL GRADUATE, Associate A. I. E. E., thoroughly experienced in power station and substation design, estimating, checking and inspecting; strong engineering and executive ability; is now open for engagement. For further information and references, address No. 9532, care of Electrical World, 1570 Old Colony Bldg., Chicago, Ill.

WANTED—A thorough and practical central station business manager and expert electrical engineer, now engaged, but would change; knows how to get results and keep them; years of proved ability; energetic, robust health; any climate; have you ever earned 100 per cent. dividends? Address 9534, care of Electrical World, New York.

POSITION WANTED as manager or superintendent by man with technical education and 12 years' experience in operation and management of electric light and power companies, both steam and hydraulic. Apply No. 9537, care of Electrical World, New York.

ELECTRIC heating engineer, thoroughly capable of designing, improving and perfecting electric heating devices, domestic and industrial, desires to contract with responsible concern; thoroughly familiar with U. S. heating patents and contemporary design. Expert machinist and can figure factory costs. Address No. 9538, care of Electrical World, 1570 Old Colony Bldg., Chicago, Ill.

YOUNG MAN wants position as switchboard operator in central power station; can take charge of substation also; five years' experience on all kinds of high-tension operation; can give best of references; Eastern states preferred. Address No. 9536, care of Electrical World, New York.

POSITIONS VACANT

The rate for "Positions Vacant" advertisements of forty words or less is one dollar and fifty cents an insertion; additional words, three cents each; payable in advance. Remittances and copy should reach this office not later than Wednesday, 12 o'clock noon, for the next succeeding issue.

Replies may be sent in care of Electrical World, 239 West Thirty-ninth Street, New York, or 1570 Old Colony Building, Chicago, as advertisers may desire.

RESIDENT AGENTS and salesmen in cities and industrial centers on commission basis wanted by manufacturers of complete lines of incandescent lamps. Address No. 7538, care of Electrical World, New York.

WANTED—One electrical and mechanical expert aid at $6.56 per diem. A competitive examination will be held at the Navy Yard, Brooklyn, N. Y., January 29, 1912, for filling the above position. For further information address Commandant, Navy Yard, New York, N. Y.

SWEDISH ELECTRICAL ENGINEERS WANTED—For the technical staff of some of our foreign representatives we require as soon as possible a number of trained engineers. Please apply to us, stating conditions, experience and references. Applicants should be unmarried and not more than 30 years of age. Applicants should possess a thorough theoretical and practical knowledge of electrical machinery and apparatus and their erection and should have been engaged in the business at least five years, should speak at least two foreign languages fluently and have had some business training in the country for which he desires employment. Applicants must agree to a 3-6 months' apprentice hip course at our works before being sent out to respective countries. This is a good opening for the right man. Allmänna Svenska Elektriska Aktiebolaget, Foreign Department Västeras, Sweden.

WANTED—Two quartermen electricians in charge at $5.04 per diem, each. A competitive examination wil be held at the Navy Yard, Norfolk, Va., Jan. 15, 1912, for filling the above positions. For further information address Commandant, Navy Yard, Norfolk, Va.

DRAFTSMEN WANTED—Must be familiar with electrical work. Those having experience on motors and generators preferred. State age, experience and salary expected. Address No. 9526, care of Electrical World, New York.

WANTED—Motor tester; familiar with A.C. and D.C. State experience and salary desired. Address No. 9524, care of Electrical World, New York.

EXPERIENCED electrical supply salesman for Iowa territory, with sales record and reference: of correct habits. DOWNING ELECTRICAL COMPANY, 208 Court Avenue, Des Moines, Iowa.

EDUCATIONAL

The rate for "Educational" advertisements of forty words or less is one dollar and fifty cents an insertion; additional words, three cents each; payable in advance. Remittances and copy should reach this office not later than Wednesday 12 o'clock noon, for the next succeeding issue.

RENSSELAER POLYTECHNIC INSTITUTE, Troy, N. Y.—Courses in Civil, Mechanical and Electrical Engineering and General Science, leading to the degree of Civil Engineer (C. E.), Mechanical Engineer (M. E.), Electrical Engineer (E. E.), and Bachelor of Science (B. S.) Special course in Engineering and Science. Splendidly equipped new engineering laboratories. Send for catalogue to the Registrar.

METERMEN WANTED to enroll for complete practical course on "Electrical Measuring Instruments and Meters." Endorsed by leading electrical men. Write for booklet, "Instruments and Meters," giving full information. Fort Wayne Correspondence School, No. 913 Shoaff Bldg., Fort Wayne, Ind.

MISCELLANEOUS

The rate for "Miscellaneous" advertisements of forty words or less is one dollar and fifty cents an insertion; additional words, three cents each; payable in advance. Remittances and copy should reach this office not later than Wednesday, 12 o'clock noon, for the next succeeding issue.

MERITORIOUS INVENTIONS often bring profits, if not fortunes; mail description of invention for free, candid opinion and estimate to apply for patent. Delay dangerous. Edward P. Thompson, M.E., Registered Patent Solicitor. Established 20 years. Served hundreds of Electrical World readers. Victor Bldg., Washington, D. C.

WANTED—A large and well-equipped factory; will make under contract or on royalty metal specialties; electrical heating devices preferred; will buy outright any patent article of merit. For further information address No. 8380, care of Electrical World, New York.

$10,000 will buy partner's interest in an electrical machinery contracting and repair business; located in New York City; established over 10 years and pays 25 per cent.; partner wishes to retire; this is a good opportunity for bright man. Address No. 8540, care of Electrical World, New York.

MANUFACTURER'S AGENT wants to correspond with manufacturers of electrical and power specialties desiring representation in New England. Address No. 9505, care of Electrical World, New York.

DO YOU WANT CHICAGO business? A responsible, live company desiring to open or reorganize their Chicago office can obtain the services of an energetic sales manager, technically trained with ten years' experience. Salary and commission only. At present earning $2,500. Address No. 9497, care of Electrical World, 1570 Old Colony Bldg., Chicago, Ill.

PROPOSALS

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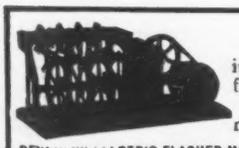
PROPOSALS FOR AUTOMATIC SIGNAL material for the relocation of the Panama Railroad—Sealed proposals will be received at the Office of the General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., until 10.30 a. m., January 25, 1912, at which time they will be opened in public, for furnishing the above-mentioned articles. Blanks and general information relating to this Circular (No. 669) may be obtained from this office or the offices of the Assistant Purchasing Agents, 24 State Street, New York City, and 614 Whitney-Central Building, New Orleans, La., and 1086 North Point Street, San Francisco, Cal., also from the U. S. Engineer Offices in the following cities: Seattle, Wash.; Los Angeles, Cal.; Baltimore, Md.; Philadelphia, Pa.; Pittsburgh, Pa.; Boston, Mass.; Buffalo, N. Y. Cleveland, Ohio; Cincinnati, Ohio; Chicago, Ill.; St. Louis, Mo.; Detroit, Mich.; Milwaukee, Wis.; St. Paul, Minn.; Chattanooga, Tenn.; Louisville, Ky.; Mobile, Ala., and Galveston, Tex.; Commercial Club, Kansas City, Mo.; Chamber of Commerce, Quincy, Ill., and Commercial Club, Tacoma, Wash.—F. C. Boggs, Major, Corps of Engineers, U. S. A., General Purchasing Officer.



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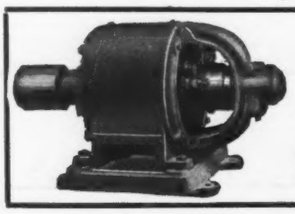

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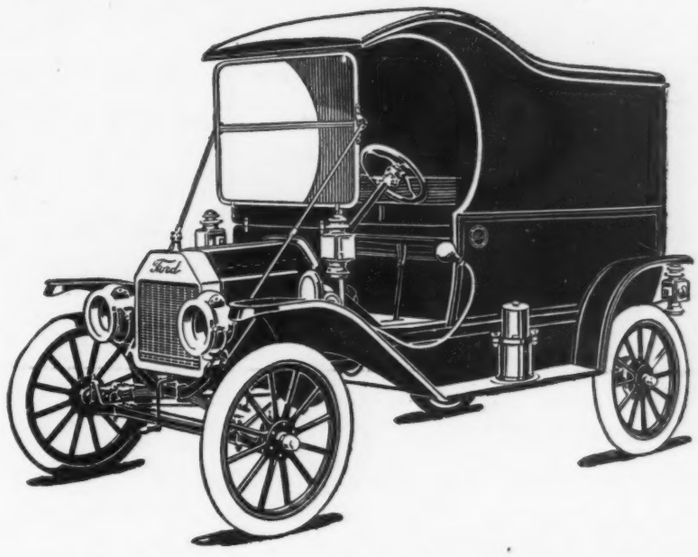

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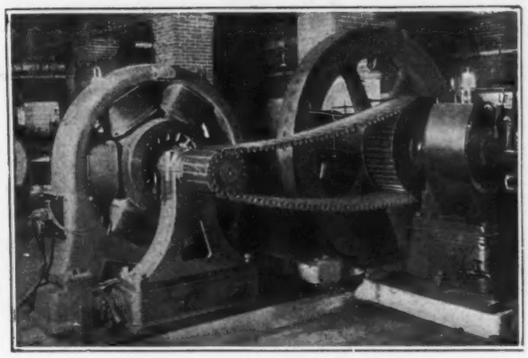

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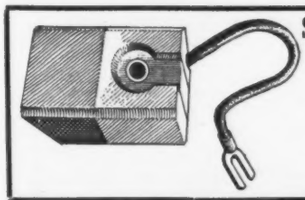

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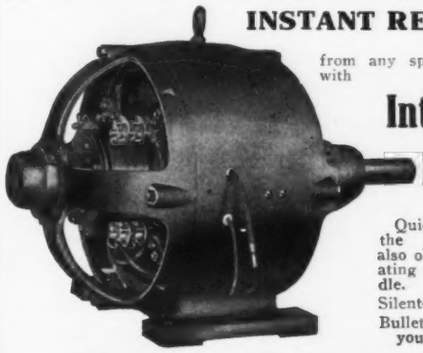

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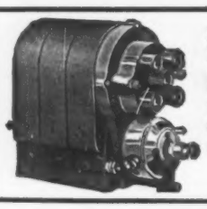

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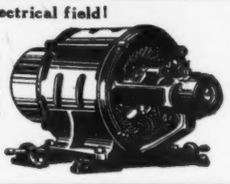

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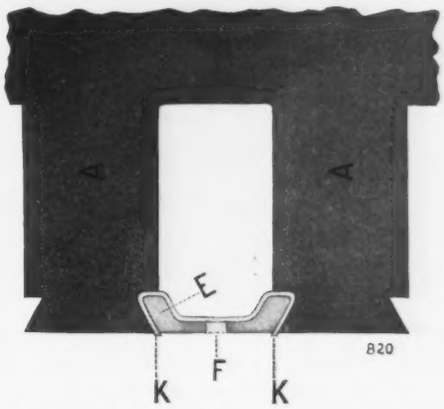


Cross section of stator slot of C-W Induction Motor.
AA—Stator teeth.
E—Steel slot bridge.
F—Opening in center of slot.
K—Insulation between bridge and teeth.

This illustration shows why

CROCKER-WHEELER
SQUIRREL CAGE
INDUCTION MOTORS

combine high insulation strength with high electrical efficiency.

Form wound coils are inserted with the bridge removed. In operation the bridge provides a path for the magnetic flux.

Pamphlet E on C-W Induction Motors contains information you ought to have.

CROCKER-WHEELER COMPANY

Ampere, N. J., Birmingham, Boston, Chicago,
Cleveland, Denver, Detroit, Newark,
New Haven, New York, Philadelphia, Pittsburg,
Syracuse. San Francisco,

FORGET FIRST COST

and fix your eye on operating cost, when buying brushes. Even though the first cost of

"Le Carbone" Brushes

is greater than that of other carbon brushes, the experience of hundreds of Central Stations prove them to be far more economical in the long run.

W. J. Jeandron

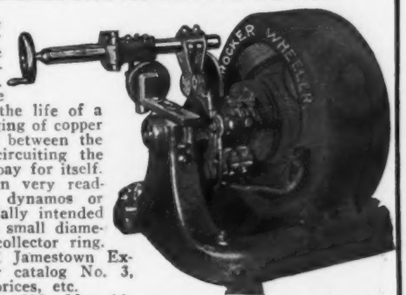
174 FULTON STREET
NEW YORK

1

JORDAN COMMUTATOR TRUING DEVICE

This device will true your commutator without removing the armature; easy to attach and operate. Does not take large cuts, which shorten the life of a commutator; no dragging of copper across the insulation between the bars, thereby short-circuiting the same, and will soon pay for itself. This type device can very readily be attached to dynamos or motors and is especially intended for machines having small diameter commutator or collector ring. Silver Medal Award Jamestown Exposition. Write for catalog No. 3, with list of users, prices, etc.

Patented April 26, 1898; May 16, 1905; Sept. 6, 1910, and Jan. 24 1911. Other patents pending.



Front View of Type J Commutator Truing Device attached to Crocker-Wheeler Motor.

JORDAN BROTHERS, Inc, 74 Beekman Street, N. Y. City

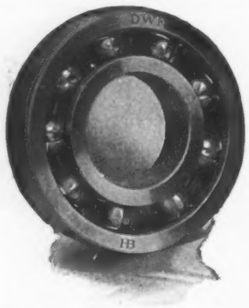
High-Grade Carbon Brushes

The heads of a thousand dynamo rooms state positively over official signature that LE VALLEY VITAE CARBON BRUSHES

Actually save their first cost again and again:
Save time, labor and annoyance;
Save commutators, keeping them unscratched and glossy;
Save shut-down losses and repair bills;
Save and make reputations for men and machinery;

Are in fact the one absolutely proven, generally admitted high-grade Carbon Brush, worthy of complete dependence and exclusive use in all places under all circumstances.

Le Valley Vitae Carbon Brush Co.
4123 Park Ave., New York City
Catalogs and Testimonials on Application.



REDUCED CURRENT CONSUMPTION

is invariably one result when motors are equipped with

Hess-Bright Ball Bearings

Some of the others are:
Constant Air-Gap
Always good Commutation
Greatly reduced repair bills.

Our catalog and data sheets are full of useful information.

Shall we send them?

The Hess-Bright Mfg. Co. 2112 Fairmount Ave., Philadelphia

You Need Not Experiment

with brushes when the superior service to be secured from

Morganite Brushes

has been acknowledged by leading European isolated and central stations.

Made of the best Ceylon Graphite.

Noiseless in operation.

Higher radial conductivity, and greater resistance across the brush, with low coefficient of friction, are features which you cannot afford to overlook.

Let us send you samples for one of your trouble-making machines.

Send us the data and we will gladly.

The Morgan Crucible Co., Ltd.
114 Liberty Street, New York City
Lewis-Roth Co., Denckla Bldg., Philadelphia, Pa.
INDIANAPOLIS BRASS Co., Indianapolis, Ind.

Peerless A. C. Motors

"Induction" type, with rotating secondary member.
No moving wires—no brushes—no commutators.
Self-starting under full load. 1/12 to 3/4 H.P. all speeds.
Full line of D. C. Motors also.

The Peerless Electric Co., Factory and Main Office: Warren, Ohio
Sales Agencies in All Principal Cities 1

Emerson Fans for 1912

Improved A. C. Fans
New Models for D. C.

A more satisfactory and extensive line than ever.

Jobbers' Contracts now ready.

The Emerson Electric Mfg. Co.
2024 Washington Ave. St. Louis, Mo.
Eastern Address, 50 Church St., New York City.

Lincoln Motors

impregnated with our special oil and waterproof varnish.

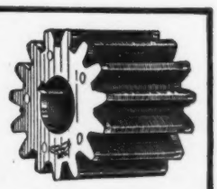
Operate Under Water

All windings both direct and alternating current are insulated in the same way.

LINCOLN ELECTRIC COMPANY
Kelley Ave. & 38th St. - Cleveland, O
918 Monadnock Bldg., Chicago, Ill.

Noiseless Pinions

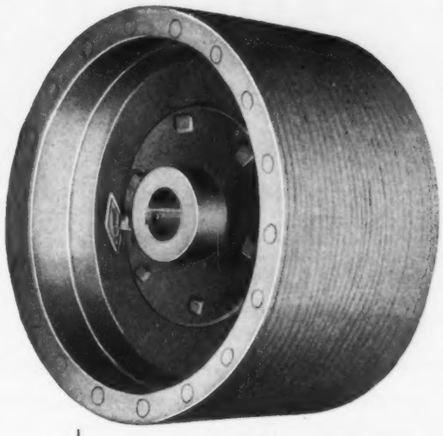
for motor and other high speed drives
See our large advertisement in first and third issues of the month.



The New Process Raw Hide Co.
500 Plum St., Syracuse, N. Y.

TROLLEYS

MARIS BROS.,
PHILADELPHIA



It's Hardly Probable

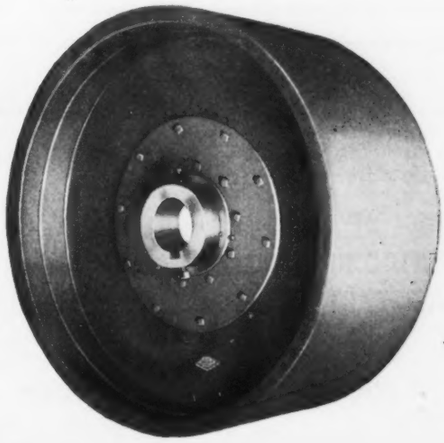
That the foremost electrical engineers and manufacturers would use Rockwood Paper Pulleys if they didn't possess real merit.

You Would Profit Immensely if You'd Only Follow the Dictates of Their Experience

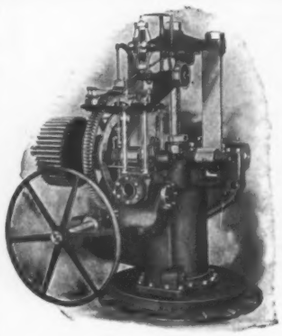
ROCKWOOD PAPER PULLEYS

are sold on the basis of proven merits. Our sales records show that.

We would like to number you one of our satisfied customers. Our files are full of engineering data and testimonials covering the adaptation of our pulleys to varied lines of work. If you are interested in any particular or special feature of belt driving, we would be glad to be of assistance to you.



The Rockwood Mfg. Co.
INDIANAPOLIS, INDIANA, U. S. A.



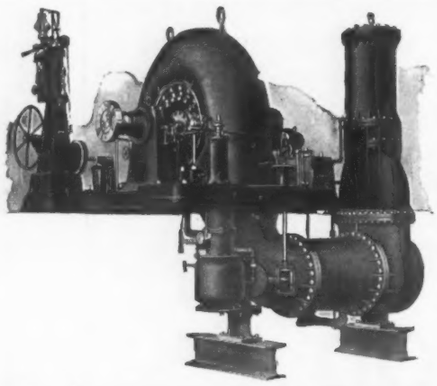
N. 14 Governor.
60,000 ft. lb. capacity.

FIRST OF ALL—RELIABILITY

The production of every one of our standard governors is the result of long continued, painstaking labor and conscientious care on the part of our employees. Our machines are governing many million horse-power of water wheels throughout the world.

Write us if you have difficult problems to solve

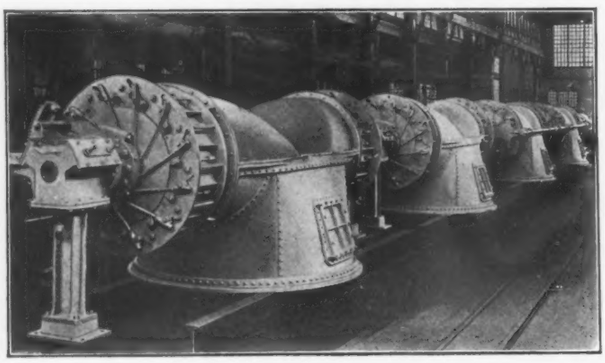
THE LOMBARD GOVERNOR CO.
ASHLAND, MASS.



HYDRAULIC TURBINES

ENGRAVING REPRESENTS
One of Three Units
Each
1700 Horse Power, 720 R. P. M., 280 Ft. Head
Furnished
Mohawk Hydro Electric Co., Ephrata, N. Y.
Turbines designed to meet all requirements for heads from 5 to 600 feet
WRITE FOR BULLETINS

S. MORGAN SMITH CO., York, Pa.
BRANCH OFFICES:
176 Federal Street, Boston, Mass. 644 American Trust Building, Chicago, Ill.

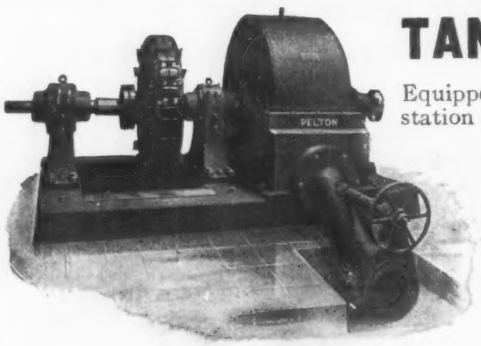


SAMSON HYDRAULIC TURBINES

7000 Horse Power

The illustration shows one of the two units installed for the Penn Iron Mining Co., Vulcan, Mich. Each unit consists of EIGHT turbines connected on ONE HORIZONTAL SHAFT which is direct coupled to generator. Head of water 25 feet, total capacity both units 7000 H.P. We build these turbines in all sizes and styles to meet various conditions. Send us your specifications and allow us to submit prices. Do you want our latest literature?

JAMES LEFFEL & CO.
308 Lagonda St. Springfield, Ohio



3-Bearing Pelton Wheel

TANGENTIAL WATER WHEELS

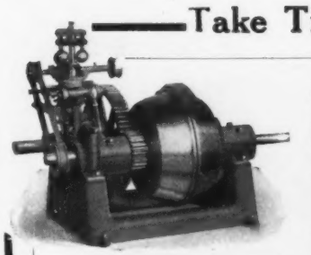
Equipped with PELTON Automatic Needle Nozzles increase the station output because of their water economizing feature.

NO DANGER OF RAMMING PIPE LINE
SACRIFICE OF EFFICIENCY
UNSATISFACTORY SPEED REGULATION

Write for particulars

THE PELTON WATER WHEEL COMPANY
2231 Harrison St., San Francisco 91 West Street, New York City

Take Time Now!

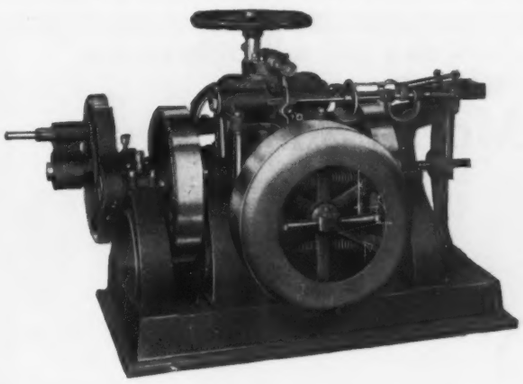


—just a few minutes—and drop us a card for our catalog. It's profusely illustrated and contains a wealth of technical facts about the

WOODWARD
Waterwheel Governor

You'll be most agreeably surprised to find out what close regulation it affords and what little attention it needs. It's a real money and trouble saver for hydro-electric operators and all others. Year's subscription to "Power Control" Free.

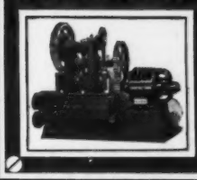
Woodward Governor Co.
202 Mill St., Rockford, Ill., U. S. A.



DEMING PUMPS

FOR OPERATION BY ELECTRIC MOTOR, GAS OR GASOLINE ENGINE, OR BELT DRIVEN FROM LINE SHAFT. CONTINUOUS FLOW FROM DISCHARGE.

Tell Us the Conditions



The Deming Company
Salem :: :: Ohio

Hand and Power Pumps for All Uses
HENION & HUBBELL :: Chicago
HARRIS PUMP & SUPPLY CO. Pittsburg
RALPH B. CARTER CO. :: New York

Sixty Days' Trial at Our Expense

We'll send experts, submit plans and install the

IMPROVED GOVERNOR FOR WATER WHEELS

with the understanding that it may be returned to us if you are not satisfied.

Holyoke Machine Company
WORCESTER, MASS. 1

TRUMP TURBINES

All styles and designs built to suit your location. Send at once for our illustrated catalog.

THE TRUMP MFG. COMPANY
Columbia & Greenmount Aves., Springfield, Ohio

Clean, Straight Threads

are always cut by a Carpenter Die when held in a

Carpenter Adjustable Stock

TRADE MARK C Registered

A pair of hardened, tempered steel jaws guide the die onto the work, and make it impossible to tip the die and cut a crooked thread.

The Carpenter Catalog describes it. Write for copy.

The J. M. Carpenter Tap and Die Co.
Pawtucket, R. I.

New American Turbines

In Vertical or Horizontal, Single or Multi-Wheel Units

See illustrated adv. first issue of month. Catalog 12-R on application.

The Dayton Globe Iron Works Co.
Dayton, Ohio, U. S. A.

WATER WHEEL GOVERNORS

Reliable—on the job—every day and minute—because made right. Close regulation for wheels of every make and size—any kind of load—any head. Fully guaranteed.

GOVERNOR DEPARTMENT, Troy
LUDLOW VALVE MANUFACTURING CO., New York

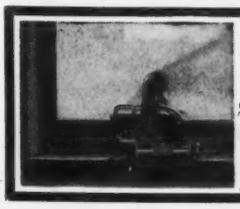
Times Have Changed

Triplex Blocks hung from overhead trolleys afford the simplest, quickest and cheapest method of lifting and transporting that the world has ever seen. Write for the Book of Hoists today.

The Yale & Towne Mfg., Co. 3
The makers of Yale Products 9 Murray Street, New York

A **FULL LINE** of Central Station Power Accessories that are up-to-date and first-class in every respect, is manufactured by

ELLIOTT COMPANY
6901 Susquehanna St. PITTSBURG, PA.



"Sirocco"
TRADE MARK REG. U.S. PAT. OFFICE
Electric Fan & Air Purifier
AMERICAN BLOWER COMPANY
DETROIT MICH

You can get a "rocker-joint" only in a

Morse Silent Chain

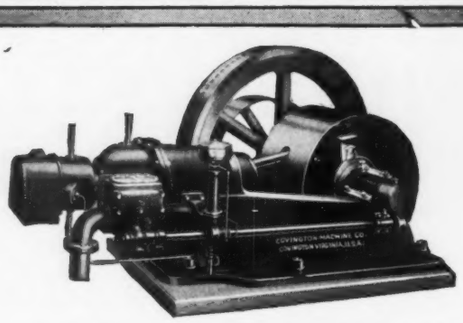
YOU can get other chains with possibly as high *initial* efficiency. You can also readily understand that the joint is the most important part of this type of chain. Upon the joint depends whether you get only initial efficiency, or sustained efficiency. The difference means more than the extra cost of the better chain.

The joint of the Morse Silent Chain consists of two steel pins, specially shaped, which work against each other on exactly the same principle as the rockers of a chair work upon the floor. This action eliminates turning and rubbing friction, and reduces wear to almost nil.

When you want a driving chain giving 99% *sustained* efficiency, get a "Rocker-Joint" and remember, that is an exclusive feature of the Morse Silent Chain. Write for Bulletin 10-X.

Morse Chain Co. **Ithaca, N. Y.**

A10



Skilled Attendance Not Required

HEAT the vaporizer cap by means of the oil or gas burner supplied with the Engine.

Give the oil pump a stroke, sending a charge of fuel oil into the vaporizer. Then open the valve admitting compressed air into the cylinder, and the Engine is started.

COVINGTON · OIL · ENGINES

are even simpler to handle than automobile engines because they have no electric sparking devices, carburetors, or other delicate parts to get out of order. Little attention required after starting.

Positive mechanical lubricator supplies the wrist pin and cylinder; lubricant baths with a few oil cups complete the equipment. Each 100-h.p. requires 1½ gallons lubricant per ten-hour day.

The fuel oil consumption is 13¾ gallons per 100-h.p. for one hour. With fuel oil at 3c per gallon the fuel cost for 100-h.p. is 40c per hour, $4.00 per ten-hour day.

These low operating costs with the correct and substantial construction of the Engines guarantee cheap power continuously. Always ready to run and built to operate at full load for many years. Low pressures. Slow speeds. Massive construction. No expensive shut-downs to absorb operating cost economies. Built for serious business.

Covington Machine Company. Works: Covington, Virginia.
B. D. POWLESON, Sales Agent - 6 Rector Street - New York

COVINGTON·OIL·ENGINES

Send Us Samples

Of the pieces in which you wish to tap threads, or send us an accurate drawing, that will show us what your work is, and we will tell you about a *Collapsing Tap* that will save you time and money.

GEOMETRIC ADJUSTABLE COLLAPSING TAP.
(For use on Turret Head Machines, or on Live Spindles.)

Being adjustable, they have the great advantage of always producing accurate work, no matter how often the Chasers have been ground, and when the Chasers are worn out, they can be replaced at small cost, while the Tap remains as good as new.

Being Collapsible, there is no backing out, for after the thread is tapped the Chasers automatically recede and allow the Tap to be withdrawn. This means no stripping of threads, and no breaking of taps, as occurs in the backing out of solid taps.

Descriptive Booklet Sent on Request.

The Geometric Tool Company
NEW HAVEN, CONN.

7

There Was a Man

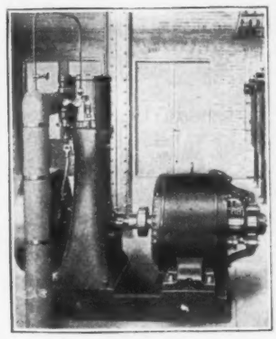
once upon a time who said
"I can't afford to advertise!"

That Man Failed!

His friend standing near him said
"I can't afford **not** to advertise!"

That Man Succeeded!

Let the **WORLD** help you solve your problem and do its part in making **YOUR BUSINESS MORE SUCCESSFUL!**



Small Generating Sets

which are compact, light, simple in construction, absolutely reliable, easily regulated and durable, meet the demand for isolated plants in Public Buildings, etc., and for exciting purposes.

We build them in sizes up to 50 K. W.

BULLETIN 1042

Allis-Chalmers Company

Milwaukee **Wisconsin**

Specialists *in* **Complete Power** *and* **Electrical Equipments**

McINTOSH, SEYMOUR & CO.

Auburn, N. Y.

VERTICAL, HORIZONTAL, **BELTED, DIRECT COUPLED**

Steam Engines

New York: McIntosh, Seymour & Co. 50 Church St.
Philadelphia: McIntosh, Seymour & Co. 1218 Chestnut St.
San Francisco: Charles C. Moore & Co. 99 First St.
Boston: J. A. Grant & Co. Tremont Bldg.
Chicago: McIntosh, Seymour & Co., 1641 Monadnock Block

With Dixon's Graphite Brushes you avoid excessive wear on the commutator.

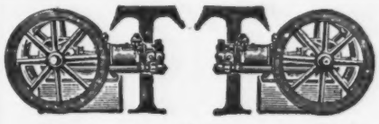
Graphite being a lubricant prevents wear on your commutator as well as reducing losses due to friction.

Booklet 47-M free on request

JOSEPH DIXON CRUCIBLE CO.

JERSEY CITY, N. J.

3



SPECIAL ELECTRIC ENGINES

Heavy construction and the OTTO Governor secure such close regulation that, under changing load from one-third to full, the variation in voltage will not exceed 2%.

We guarantee this steadiness.

OTTO isolated electric plants with storage batteries furnish dependable power and lights 24 hours a day. Ask us today to mail you a bulletin describing a plant the size you now need. You will soon see why the OTTO has kept in the lead for 35 years and has over 100,000 engines now in use.

Operate on city gas, natural or producer gas, gasoline, alcohol or distillate.

THE OTTO GAS ENGINE WORKS 3207 Walnut Street Philadelphia, Pa.

DEARBORN TREATMENT

KEEPS YOUR BOILERS CLEAN AND SAVES SHUTDOWNS AND OVERTIME WORK.

All boiler waters contain incrusting or corrosive salts. Dearborn Treatment counteracts these salts and makes them harmless. It is fed into the boilers with the feed water and works constantly, so that there are no shutdowns for cleaning, no night or Sunday work, and the boilers are kept in good condition ALL THE TIME. Send gallon of water for analysis.

DEARBORN DRUG & CHEMICAL WORKS, McCORMICK BUILDING, CHICAGO

BRANCHES
Atlanta
Boston
Chicago
Cincinnati
Cleveland
Denver
Havana, Cuba
Los Angeles

THE BABCOCK & WILCOX COMPANY

85 Liberty Street, New York

WATER TUBE BOILERS

Steam Superheaters Mechanical Stokers

BRANCHES
New Orleans
Philadelphia
Pittsburgh
Portland, Ore.
Salt Lake City
San Francisco
Seattle

Centralize the Heat Distribution

of your city or town—Utilize your Central Station Exhaust for steam heating, and thereby fully develop the income producing qualities of the coal you must use. By selling your exhaust steam for heating purposes you not only centralize the heating system of your community—you eliminate for your customers the dirt and bother of individual heating plants, and you make a handsome profit on your by-product. In the

American District Steam Heating System

with everything worked out in complete detail hundreds of stations throughout the country have found the successful means of augmenting their income. In their successful efforts to centralize heat distribution they have found truly profitable and exceedingly economical plant operation.

American District Steam Co.
Main Office and Works:
NORTH TONAWANDA, N. Y.
CHICAGO LOCKPORT, N. Y.

We can help you attain the same end. Ask us for the data and for our new booklet "Central Station Heating."

Central Power or Electric Lighting Plants Convert Waste Steam into Profit Through "MICHIGAN" Steam Pipe Casings!

SELL YOUR WASTE HEAT

SAVE YOUR HEAT ENERGY

A Tin Lined Wood Casing for Insulating Underground Steam Pipes which is composed of the Most Efficient Non-Conductive Materials Known.
ABSOLUTELY WATERPROOF

THE MICHIGAN PIPE CO. **BAY CITY, MICH.**

You can Improve your Condensing Apparatus by installing Efficient Auxiliaries which can be relied upon; which are simple durable and economical—in short

Alberger Centrifugal Pumps

They are displacing direct acting pumps for circulating purposes in every instance. Centrifugal, Volute and Turbine—Proven superiority for all practicable combinations of head and quantity. Write,

Alberger Pump Company
140 CEDAR STREET, NEW YORK
Chicago St. Louis San Francisco Pittsburg 5

COCHRANE

Feed Water Heaters and Purifiers
Feed Water Heaters and Receivers
Steam and Oil Separators
Sorge-Cochrane Hot Process System of Water Softening
Harrison Safety Boiler Works
3159 N. 17th St., Philadelphia, Pa.

ATWOOD

Valves and Fittings

All Sizes For All Purposes
Complete Piping Systems
Pittsburgh Valve Foundry And Construction Co., Pittsburgh, Pa.

Here's A Load That's Absolutely Certain To Return A Good Profit All The Time

You can add $10 to $20.00 a day to your income by operating a

York Ice Machine

during your periods of light load. Each horse-power of engine capacity will yield about 600 lbs. of crystal-clear, pure ice, which the local dealer will be glad to buy at $2.00 to $3.00 per ton.

York Machines are made in both compression and absorption types. They require no attendance in addition to your regular engine and boiler room help and the possibility of increased business will be limited only by the capacity of the ice plant.

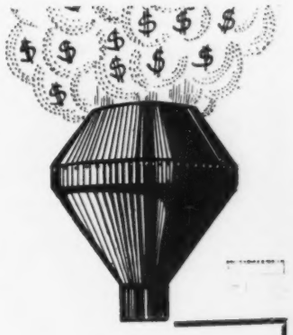
YORK MANUFACTURING CO. - - York, Pa.

LARGEST ICE MACHINE MANUFACTURERS IN THE WORLD

General Western Offices: Monadnock Block, Chicago

BRANCHES in Boston, New York, Philadelphia, Pittsburg, Atlanta, Cincinnati, St. Louis, Houston, Los Angeles, Oakland, Seattle

Turn the Waste to Profits



Stop exhausting your steam into the atmosphere. Use it in a

Carbondale Ice Machine
For Making Ice

The amount you can sell is limited only by the size of your plant. For every H. P. generated you can make 600 lbs. of perfectly hygienic ice that will be much preferred to natural ice.

And the operation of ice plant can be regulated to suit your own convenience.

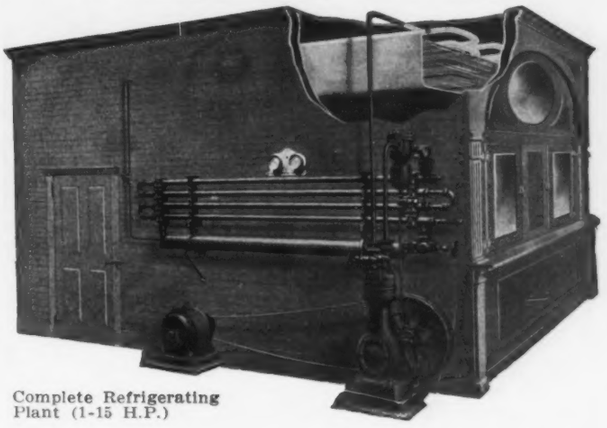
Let us send you the details.

CARBONDALE MACHINE CO.
Carbondale, Pa.

Eastern Office: 50 Church St., New York

Western Office: 1013 Manhattan Bldg., Chicago

Supplying Mechanical Refrigeration Yields

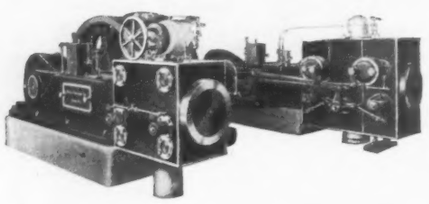


Complete Refrigerating Plant (1-15 H.P.)

Handsome Returns to the Central Station

Mechanical Refrigeration will save butcher shops, dairies, cafés and hotels, confectioners and ice cream manufacturers 66⅔% in their ice bills. Dry refrigeration for butcher shops especially, quickly pays for itself in meat saved which would otherwise become tainted through moisture. Central stations supply the equipment and energy. Write for the details.

Baker Ice Machine Co., - Omaha, Neb.



The Success of Corliss Engines at Slow Speeds is unquestioned.

The drop cut-off gear is responsible.

The Success of Ball Corliss Engines at High Speeds is unquestioned.

The non-detaching Valve Gear is responsible.

This gear is patented. It is found only in Ball Engines. By its positive action it gives the valves the *same Movement* that the *Drop-Cut-off* of the Slow Speed Corliss *produces* by picking up and dropping them. It also permits the use of *true Corliss Valves*—the valves that have survived the test of time—the valves that wear least, remain tight longest, and operate with the minimum amount of steam.

On account of their superior economy, close regulation, and noiseless operation, Ball Corliss engines are used in many important light and power plants. List of installations will be gladly furnished.

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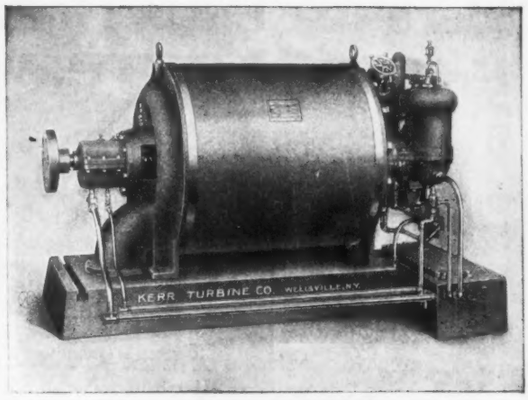

Kerr Turbines Maintain High Steam Economy Over Wide Load Range

The steam economy of a Kerr Turbine at rated load may not be quite as good as that of an expensive reciprocating engine, but the steam economy is decidedly better at other loads than the rating.

A reciprocating engine operates with maximum steam economy at only one load. At other loads, the cut-off coming too soon or too late for the best expansion considerably increases the steam consumption. As a power load can seldom be held constantly at a given point, the average economy of a reciprocating engine is not nearly so good as the best obtainable figure.

The steam consumption of a Kerr Turbine is comparatively good at fractional loads for non-condensing turbines and for condensing turbines the water rate is practically a flat curve. The steam economy improves as the load increases. Typical water rate curves indicate that the Kerr Turbine may be operated non-condensing over more than half its range with a variation between the best and poorest economy of not more than 10 percent from the average and condensing with less than 5 percent variation. Kerr Turbines are rated conservatively and are not harmed by moderate overloads of ordinary practice. Hence they operate at uniform high economy on widely varying loads.

Provision for additional power during overload periods, without sacrificing economy at lighter loads, can be made, where desirable, by the use of a valve which opens additional nozzles on the first stage of the turbine. This is not a by-pass valve, properly speaking, as none of the steam is "by-passed," that is, passed around one or more stages of the turbine, as all the steam passed through this valve does work in each stage of the turbine. Such a device is made use of also to provide sufficient capacity when it is desired to operate a condensing turbine to carry full load non-condensing, or in other cases where better operating efficiency can be secured by its use.

Kerr Turbines have found a large field of application. They are especially adapted to driving generators, blowers, centrifugal pumps, etc. at speeds varying from 700 to 4000 r.p.m. If you are figuring on an installation write for our literature and state conditions: our engineers will gladly advise and figure with you.

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STEAM KERR TURBINE
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Agents in all large cities

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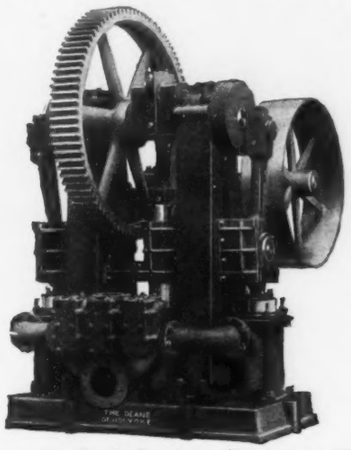

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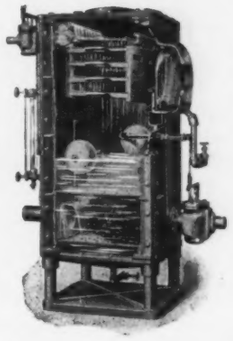

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3—It thoroughly filters and purifies the feed water.

4—It acts as a storage tank for the water of condensation.

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Works: East Cambridge, Mass.
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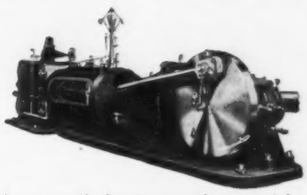

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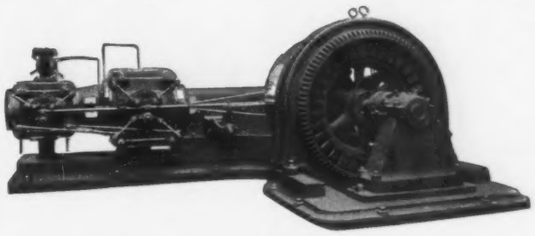

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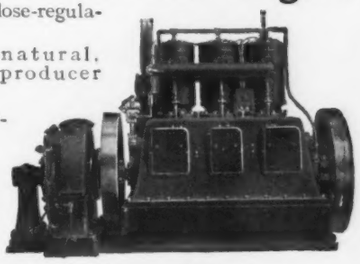

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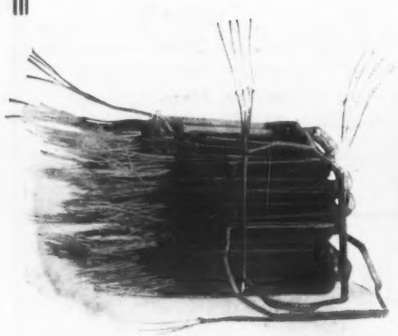

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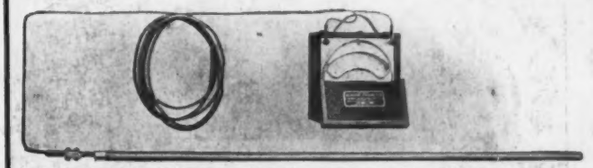

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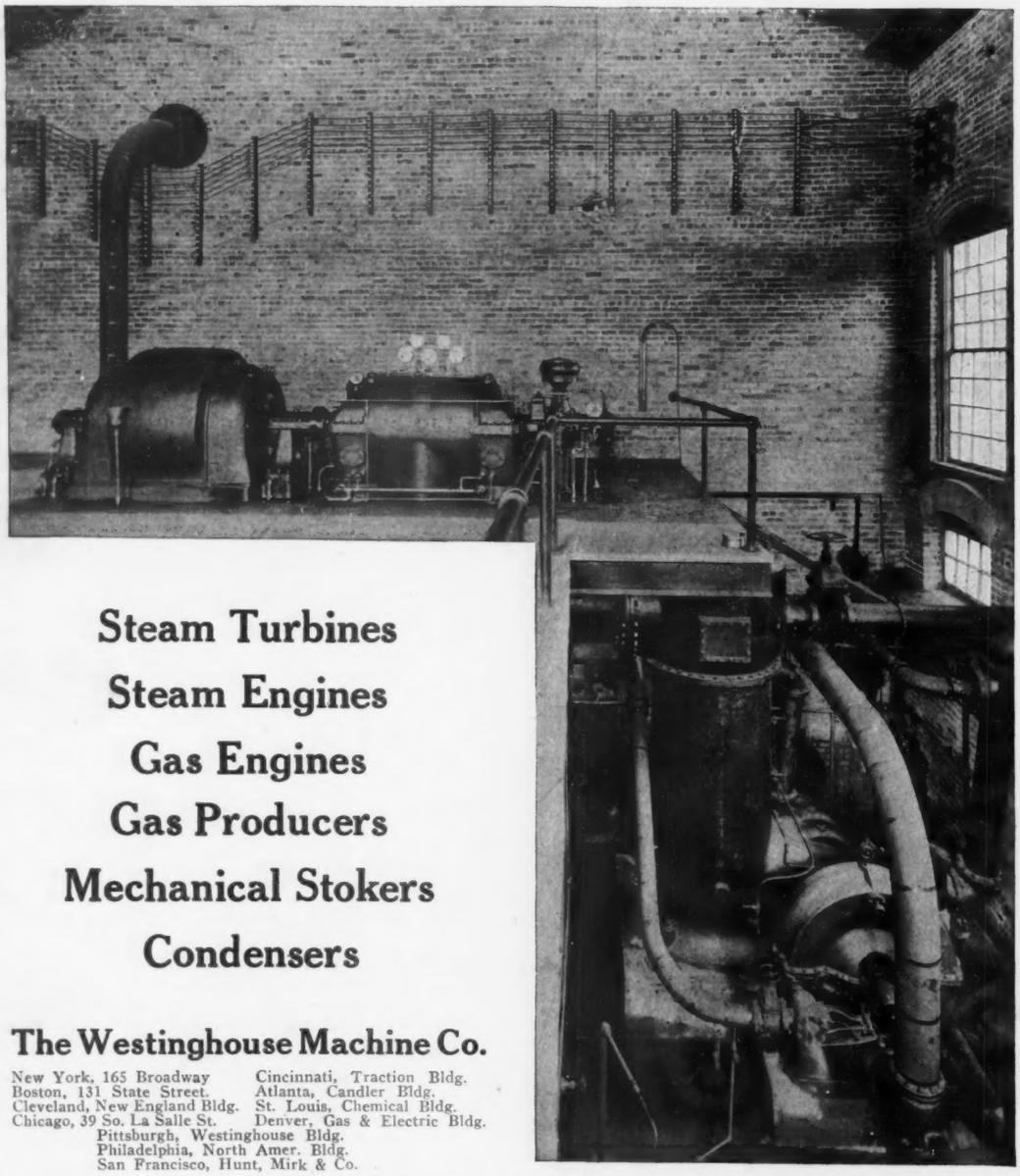

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